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THE AMERICAN
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Gas Analyses by Fractional Distillation at Low Temperatures.[1]

By G. A. BURRELL and F. M. SEIBERT.

This paper describes experiments that resulted in the separation of a natural gas sample into the individual paraffin hydrocarbons, which had not been accomplished hitherto.

Natural gases may contain only methane as the combustible constituent, or may be mixtures containing large quantities of the higher gaseous paraffins. In addition, there may be vapors of the liquid paraffin hydrocardons present, sometimes enough to warrant the installation of a plant for their extraction. The natural gas used in Pittsburgh is a complex mixture typical of the gas supplied to many cities, to the extent of billions of cubic feet per year. The exact composition of this gas is of importance to the Bureau of Mines because it is used in testing explosives, safety lamps, electrical mining machinery, and other mining appliances. By the scheme shown herein, it is possible to determine more closely the quantity of the vapors of the liquid paraffins in a natural gas mixture than has been possible heretofore. It is generally known that combustion gas analyses give but little indication regarding the individual hydrocarbons present in a natural gas mixture showing only the two predominating paraffins.

1. From a paper presented before the American Chemical Society, by permission of the Director of the Bureau of Mines.

In these experiments natural gas was first liquefied by means of liquid air, the different paraffin hydrocarbons separated by properly adjusting temperatures and removed with a mercury pump; and the fractions analyzed by the ordinary slow combustion method. Advantage was taken of the work of P. Lebeau and A. Damiens, who prepared various mixtures of the gaseous paraffins, liquefied them and partially separated them. This work is in advance over theirs in that the separation was made into single constituents. The important part of this paper, however, is the application of the work to the determination of the constituents of natural gas. Such a separation is possible because, in the liquid condition, the boiling points of the gaseous paraffins are rather widely separated. These boiling points are: Methane, —160°; ethane, —93°; propane, —45°; N butane, + 1°; and isobutane, —16°. These two butanes were not separated.) In order to finish the work with fractions large enough for accurate analyses, the experiment was started with about 1½ liters of gas (1,531 cc.). Others experiments were performed with various natural gases in which smaller quantities were used. The sample analyzed by the ordinary slow combustion method, contained the following constituents:

Methane, per cent	.....	79.2
Ethane "	.....	19.6
Nitrogen "	.....	1.2
		100.0

There is also about 0.03 per cent. of carbon dioxide in the gas mixture; carbon monoxide, hydrogen and olefine hydrocarbons are not present.

Fig. 1 shows the general arrangement of the apparatus. (*A*) is a small glass vessel used for holding the liquefied gases. It could be enclosed in the Dewar flask (*B*). Surrounding this Dewar flask is shown another and larger one. This arrangement was adopted in order to provide better insulation than is afforded by one flask, although the work can be conducted with one. The gas sample, prior to liquefaction, was measured by weighing the water displaced from the glass vessel (*C*), then transferred to the gas burette (*D*), and from there passed into the liquefying bulb (*A*). At (*E*) is a mercury manometer for registering pressures in the pump. At the base of the Töpler (on the left) pump are the glass vessels for trapping the different gas fractions over mercury as removed.

The entire sample was first liquefied; and connection made between it and the mercury pump, and as much of the gas removed with the pump as possible. This divided the original quantity into two portions: a gaseous portion and a liquid residue, In other words, the vapor pressure of liquid ethane (b.p.—93°) is so small at the temperature of liquid air that none could be detected in the distillate within experimental error of the analysis. It was found that when the liquid air used had stood for some time, so that its boiling point had risen nearly to the boiling point of oxygen (—183°), the methane and nitrogen were removed from the original mixture more quickly than when newly made liquid air was used. This is to be expected. The residue from this first fractionation was allowed to volatilize, measured and again liquified at the temperature of liquid air. Connection was again made to the pump and more methane removed. In other words, although the residue from the first fraction was treated in exactly the same manner as the original sample more methane was obtained.

Upon volatilizing the entire residue, however, and again liquefying, a rearrangement of the solution occurred and chance for faster evaporation of this last methane portion was afforded. In no case

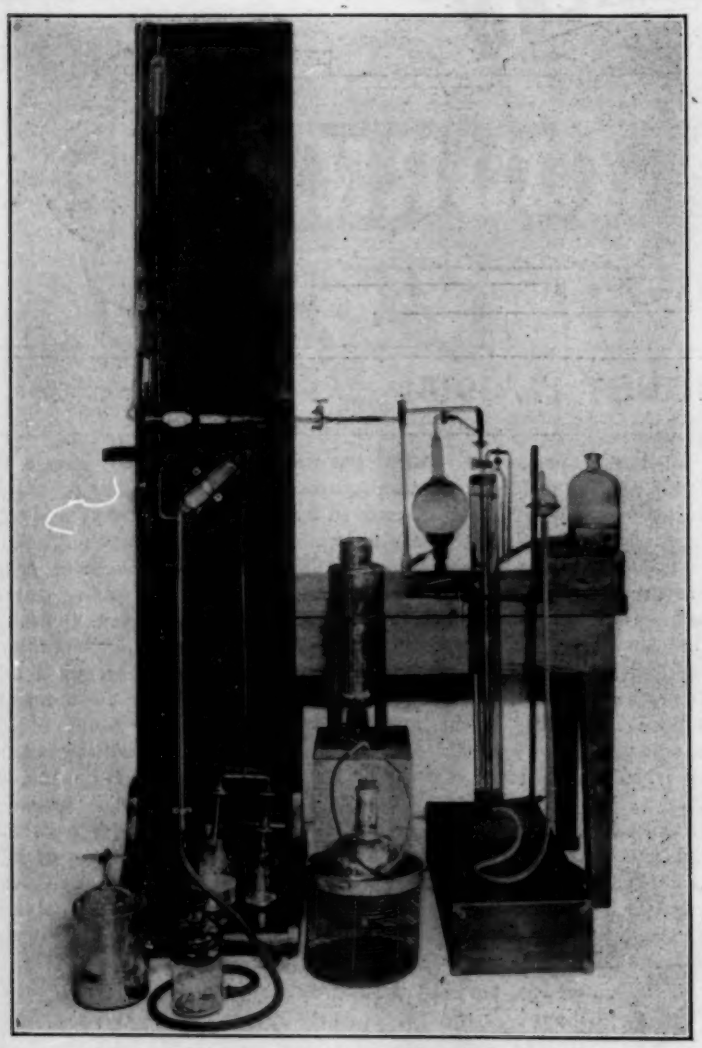


Fig. 1.—Apparatus for the Liquefaction and Fractionation of Gas Mixtures.

could the last minute traces be obtained, so the attempts at complete recovery were stopped when the small proportion left behind did not sensibly affect the results.

TABLE I.—*Analysis of a Portion of the Total Methane and Nitrogen Fraction.*

	Cc	Cc.
Sample taken	30.10	30.20
O_2 added	95.20	99.30
Total volume	125.30	129.50
Volume after combustion	66.30	70.10
Contraction due to combustion	59.00	59.40
Volume after CO_2 absorption	36.80	40.50
CO_2 produced by combustion	29.50	29.60
Methane and contraction	29.44	29.64
Methane from CO_2	29.59	29.67
	Per Cent.	Per Cent.
Methane from contraction	97.8	98.2
Methane from CO_2	98.3	98.2
Average per cent. methane	98.1	98.2

To this point the first series of fractionations had reached a stage where the larger portion of the methane had been removed and where the first residue had been volatilized, reliquefied and pumped to obtain another small proportion of methane. This residue from the second liquefaction was treated again in the same way and more methane obtained. A further identical treatment resulted in no additional recovery of methane. No indication of methane was found in the ethane portion, within the error of the analysis. The distillate obtained by this scheme undoubtedly contained trace of ethane, but it was too small to be detected. The analysis of a portion of the total methane and nitrogen fraction is given in Table I.

Second Series of Fractionations.—The next step in the process involved the separation of the ethane from the methane-free residue, and necessited a ten perature such that practically all of the ethane could be separated from the higher paraffins, propane, the butanes, etc. The temperature used could not be too low, else the ethane itself could not be separated, nor so high as to also remove all the propane. A natural gas condensate, obtained from a natural gas gasoline plant, proved excellent, when cooled by liquid air, for obtaining low temperatures higher than the temperature of liquid air. The condensate is known in the natural gas gasoline trade as "wild" gasoline, and contains large quantiites of liquid propane and the butanes (especially the latter), as well as some of the ordinary gasoline constituents, the pentanes, hexanes, etc. Other substances tried for obtaining low temperatures, alcohol, ether, methyl and ethyl chloride, etc., jellied so much at low temperatures that they could not be used satisfactorily, and the mass did not remain of uniform temperature from top to bottom.

For instance, in order to obtain a temperature of —145°, the condensate was placed in a Dewar flask and stirred with a test tube into which liquid air was run until —145° was reached. Upon removal of the liquid air, the condensate warmed up very slowly, about 5° to 10° per hour, thereby affording sufficient time for the withdrawal of vapors from the liquefaction bulb. In separating ethane from the methane-free residue, the latter was first cooled to —145° and pumping was started and continued until the temperature had risen to —125°. By this process there was obtained a distillate consisting of ethane and propane. In other words, some propane (b. p.—45°) is removed at —125°, as well as the ethane (b. p.—93°). The residue was then treated twice in the same manner, the final separation of the ethane being made at a temperature of —135° to —140°. The temperature was purposely lowered to —125° the first time to obtain practically all of the ethane as well as some propane, because it was found quicker to separate the ethane from that part of the propane that came over than to attempt to pull off all of the ethane from the original residue. All the ethane was obtained, there being only small quantities of propane remaining as a residue. The analysis of a portion of the total ethane fraction is given in Table II.

TABLE II.—*Analysis of a Portion of the Total Ethane Fraction.*

	(1) Cc.	(2) Cc.
Samples taken	25.50	20.30
O_2 added	96.60	99.40
Total volume	122,10	119.70
Volume after combustion	58.50	69.20
Contraction due to combustion	63.80	50.50
Volume after CO_2 absorption	7.20	28.70
CO_2 produced by combustion	51.10	40.50

According to the equation $C_2H_6 + 3.5\ O_2 = 2\ CO_2 + 3\ H_2O$, the contraction should be equal to the $CO_2 + 1.25$. In Analysis No. 1 the contraction then becomes 51.1 cc. + 1.25 = 63.87 cc. This corresponds well with the contraction actually observed, 63.80 cc. In Analysis No. 2 the contraction is equal to 40.50 cc. + 1.25 = 50.62. The contraction actually observed is 50 50 cc. In calculating the ethane from the carbon dioxide and contraction, use was made of equations that correct for the deviations of carbon dioxide and ethane from the ideal conditions, as follows:

Analysis No. 1.

$0.990\ C_2H_6 + 3.5\ O_2 = 1.992\ CO_2 \times 3H_2O$

cc. ethane = 0.396 + contraction = 25.26

cc. ethane = 0.497 + CO_2 = 25.39

Analysis No. 2.

$0.990\ C_2H_6 + 3.5\ O_2 = 1.994\ CO_2 + 3H_2O$

cc. ethane = 0.397 + contraction = 20.05

cc. ethane = 0.496 + CO_2 = 20.09

Third Series of Fractionations.—The final residue from the second series of fractionations then contained propane and higher paraffins. The ethane-free residue was next liquefied and pumped at a temperature that started at —125° and ended at —110°, the object being to remove practically all of the propane (b. p.—45°) and also some of the butanes (b p. + 1° and —10°.) The residue from this operation was again treated in the same manner to obtain any propane that still remained behind. It was thought that, if a temperature was used that would permit the distillation of an appreciable quantity of butane, practically all of the propane should come over. The total distillate obtained in this manner was then liquified and pumped at a temperature ranging from — 135° to — 120°. There resulted a distillate consisting of propane only. In other words, propane can be separated from the butanes at a temperature below —135° and —120°.

The analysisof a portion of the total propane fraction is given in Table III.

TABLE III.—*Analysis of a Portion of the Total Propane Fraction.*

	Analysis No. 1. Cc.	Analysis No. 2. Cc.
Sample taken	12.60	13.30
O_2 added	99.80	97.20
Total volume	106.40	110.50
Volume after combustion	67.60	70.00
Contraction due to combustion	38.80	40.50
Volume after CO_2 absorption	28.50	29.70
Carbon dioxide produced	39.10	40.30

According to the equation $C_3H_8 + 5O_2 = CO_2 + 4H_2O$, the contraction $- CO_2 = 0.0$. In analysis No. 1. 38.8 cc. $-$ 39.1 cc. $= -0.3$ cc. and in analysis No. 2 40.5 cc.$-$40.3cc.$=$0.2cc. The propane was calculated from the following corrected equation: $0.986\ C_3H_8 + 5O_2 = 2.991\ CO_2 + 4H_2O$.

Then, according to analysis No. 1, the propane, when calculated from the contraction, is $0.329 \times 38.80 = 12.76$ cc. and, when calculated from the CO_2, is $0.329 \times 39.10 = 12.86$ cc.

According to analysis No. 2 the propane, when calculated from the contraction, is $0.329 \times 40.50 = 13.32$ cc. and, when calculated from the CO_2, is $0.329 \times 40.3 = 13.26$ cc.

In the case of both analyses the cc. of propane as calculated from the CO_2 and the contraction agree closely.

The value 0.986 or the molecular volume of propane at 0° and 760 mm. of mercury was calculated from van der Waals' equation.

This value, as far as the authors are aware, has never been determined experimentally as in the case of oxygen, methane, ethane and carbon dioxide.

The same procedure was followed in the case of the propane separation as in the case of the ethane and methane separations. Distillates and residues were liquefied and pumped until no propane could be obtained. The analysis of a portion of the final residue is given in Table IV. This should consist of butane only, providing no vapors of the liquid paraffins were present.

TABLE IV.—*Analysis of a Portion of the Total Butane Fraction.*

	Cc.
Sample taken	9.30
O_2 added	100.00
Total volume	109.30
Volume after combustion	76.30
Contraction due to combustion	33.00
Volume after CO_2 absorption	39.30
CO_2 produced by combustion	37.00

From the equation $C_4H_{10} + 6.5\ O_2 = 4\ CO_2 + 5\ H_2O$, the contraction $\times$ 1.14 $= CO_2$. From the above analysis, $33.0 \times 1.14 = 37.62$ cc. $37.62 - 37.00 = 0.62$ cc. difference.

The above analysis was calculated to butane only, and appears to be almost entirely this gas, but undoubtedly a very small proportion of the vapors of the liquid paraffins were contained in the mixture.

Vapor pressures obtained by means of a manometer attached to the pump furnished evidence which indicated when a separation had been accomplished. For instance, at the temperature of liquid air that had stood for some time (about $-185°$) the vapor pressure of the original hydrocarbon mixture was 63 mm. This vapor pressure was not the pressure of methane at that temperature; it remained near this value throughout the pumping until near the end, when it suddenly dropped to 0.0 mm. Then the pumping was stopped and the residue allowed to volatilize and again liquefied and pumping continued until no more distillate was obtained.

Three liquefactions of the residues were usually necessary for the removal of all the methane.

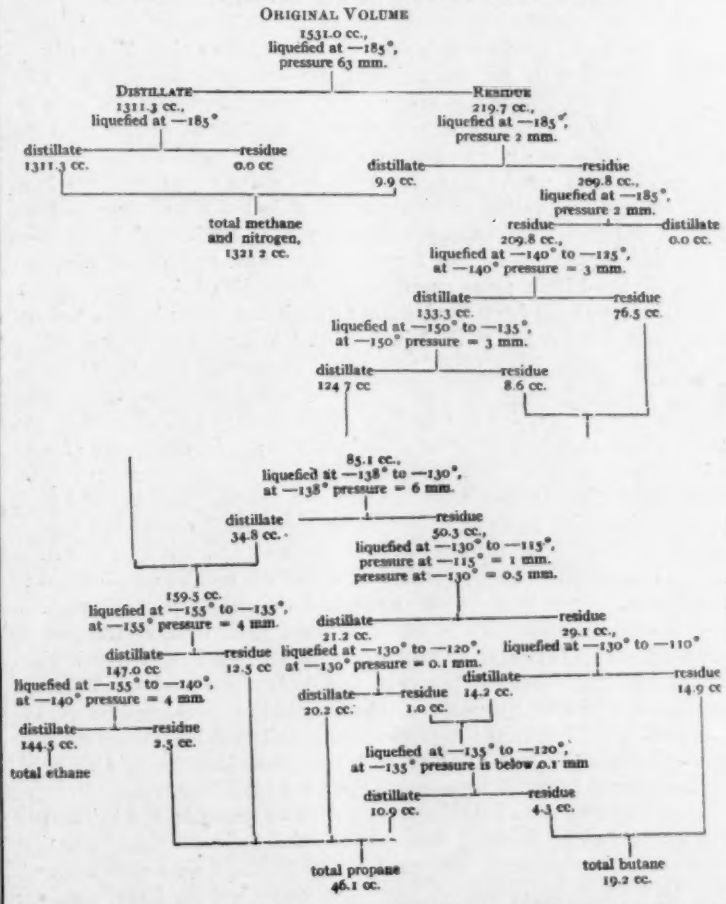
When the methane and nitrogen free residue was liquefied for the removal of the ethane, the vapor pressure of the mixture, was about 2 mm. at $-155°$ and about 4 mm. at $-145°$. When nearly all the ethane was removed and pressure dropped off suddenly to 0.0 mm., the pumping was stopped. The residue was again liquefied and treated in the same manner until all the ethane was removed. Three successive treatments of the residues were usually sufficient.

After the removal of the nitrogen, methane and ethane from the mixture had been accomplished, it became necessary to separate the propane from the butanes, etc. This was accomplished at $-130°$ to $-120°$. The vapor pressure at $-130°$ was about 0 5 mm., and about 1 mm. at $-125°$. The pressure dropped suddenly to 0.0 mm. after nearly all the propane had been removed. The residues were then treated as previously described, until all the propane had been removed. The final residue consisted of the butanes, and any vapors of the liquid hydrocarbons that were present. There follows a list of the constituents found by the foregoing method:

Constituents.	Co.	Per Cent.
Nitrogen	23.8	1.6
Methane	1297.4	84.7
Ethane	144.5	9.4
Propane	46.1	3.0
Chiefly Butanes	19.2	1.3
Total	1531.0	100.0

Table V is a diagram of the various steps in the separation. It will be noted that the original volume of the sample was 1531.0 cc. The sample was first liquefied with liquid air and a distillate of 1311.3 cc. obtained with the mercury pump, leaving a residue of 219.7 cc. behind. Both the residue and distillate were again treated at the temperature of liquid air. From the residue there was obtained 9.9 cc. more of methane, but no residue remained behind upon treating the distillate of 1311.3 cc. The sum of 9.9 cc. and 1311.3 cc. represented practically all of the methane and nitrogen in the natural gas sample. The distillate from the reliquefaction of the residue contained no methane, as determined by a further treatment at the temperature of liquid air.

TABLE V.—*Showing the Steps in the Separation of the Constituents of the Gas by Distillation at Low Temperatures.*


ORIGINAL VOLUME
1531.0 cc., liquefied at —185°, pressure 63 mm.
DISTILLATE 1311.3 cc., liquefied at —185°
RESIDUE 219.7 cc., liquefied at —185°, pressure 2 mm.
distillate 1311.3 cc.
residue 0.0 cc
distillate 9.9 cc.
residue 209.8 cc., liquefied at —185°, pressure 2 mm.
total methane and nitrogen, 1321 2 cc.
residue 209.8 cc., liquefied at —140° to —125°, at —140° pressure = 3 mm.
distillate 0.0 cc.
distillate 133.3 cc.
residue 76.5 cc.
liquefied at —150° to —135°, at —150° pressure = 3 mm.
distillate 124 7 cc
residue 8.6 cc.
85.1 cc., liquefied at —138° to —130°, at —138° pressure = 6 mm.
distillate 34.8 cc.
residue 50.3 cc., liquefied at —130° to —115°, pressure at —115° = 1 mm. pressure at —130° = 0.5 mm.
159.5 cc. liquefied at —155° to —135°, at —155° pressure = 4 mm.
distillate 147.0 cc
residue 12.5 cc
distillate 21.2 cc.
residue 29.1 cc., liquefied at —130° to —110°
liquefied at —130° to —120°, at —130° pressure = 0.1 mm.
liquefied at —155° to —140°, at —140° pressure = 4 mm.
distillate 144.5 cc.
residue 2.5 cc.
total ethane
distillate 20.2 cc.
residue 1.0 cc.
distillate 14.2 cc.
residue 14.9 cc
liquefied at —135° to —120°, at —135° pressure is below 0.1 mm
distillate 10.9 cc.
residue 4.3 cc.
total propane 46.1 cc.
total butane 19.2 cc.

After the methane had been separated, there remained a residue of 209.8 cc., consisting of ethane and higher paraffin hydrocarbons. This residue was cooled at temperatures ranging from $-140°$ to $-125°$ and as much gas removed with the pump as possible. Ethane and some propane were obtained (133.3 cc.) and a residue of 76.5 cc. remained behind. The distillate was then cooled to temperatures ranging from $-150°$ to $-135°$ and a distillate of 124.7 cc. obtained, and a residue of 8.6 cc. This 8.6 cc. residue was added to the 76.5 cc. residue and the total, 85.1 cc., cooled from $-138°$ to $-130°$ and pumped. The distillate of 34.8 cc. obtained was added to the 124.7 cc. distillate previously obtained and the total 159.5 cc. was cooled and pumped at a temperature that did not rise above $-135°$. There was obtained a distillate of 147.0 cc. and a residue of 12.5 cc. The 147.0 cc. distillate was then cooled and pumped at a temperature not higher than $-140°$. The distillate 144.5 cc., was found to be pure ethane. The residue from this last treatment, 2.5 cc., was added to the rest of the methane- and ethane-free gas for the propane treatment. The separation of the propane and butane was carried on in a manner similar

to the methane and ethane separations using lower temperatures Temperature measurements were made with two pentane thermometers. They agreed closely with each other, and gave for the melting point of chloroform —62°, of carbon disulfide —111°, and boiling point of fresh liquid air —193°. The true melting point of chloroform is —63.7°' and of carbon disulfide —111.6°. All temperatures are in degrees centigrade.

Summary.—A method of separation of a natural gas into its paraffine hydrocarbons is shown. At a temperature of — 185° to — 190° the methane can be removed. The separation of the methane from the propanes, butanes, etc., is conducted at temperatures ranging from — 150° to — 140°. The propane is separated from the butanes, etc., at temperatures ranging from — 135° to — 120°.

This method of separating a gaseous mixture into its constituents, while somewhat involved, is the only known method in the case of some hydrocarbons. It can be extended to the separation of other gaseous mixtures.

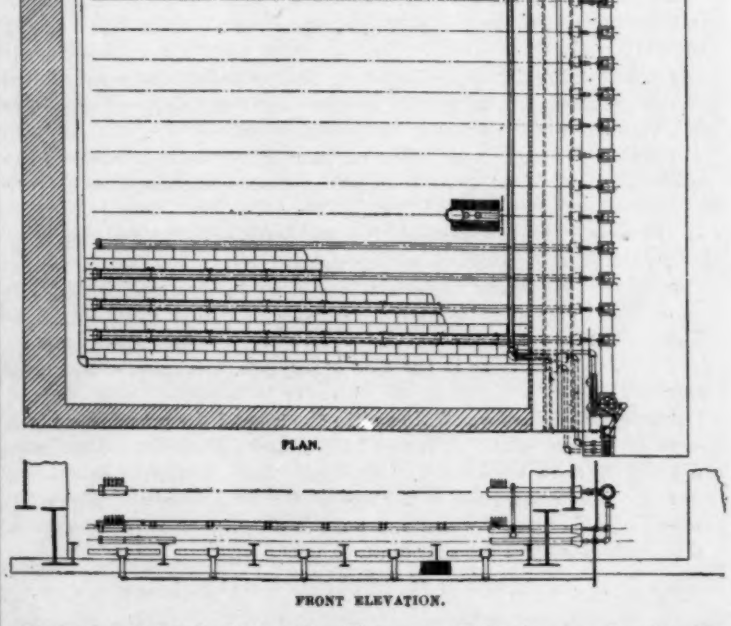
An Experiment in Biscuit Baking with Gas.

[Paper read by H. E. Watson, before the Mid-Year Conference, N. C. G. A.]

Believing that a large biscuit manufacturing company in our city would be glad to adopt the use of gas as fuel in reel ovens, providing the cost of operation would not be prohibitive, we tried to learn if gas was being used for this purpose in any other city. The only information we could get was that one gas company had put in a trial installation which did not stay; so we were thrown on our own resources. Arrangements was made with the biscuit company to put a trial installation in the smallest oven—we to stand all the expense, except for gas used. The fire box and space under reel was filled with ashes and levelled to within about 2 feet of the shelves in their lowest position. To supply secondary air, horizontal brick flues were laid parallel with the front of the oven, connecting with the outer air by 4-inch pipes run through the walls of the oven. About two-thirds way up from the bottom of each flue was placed a strip of sheet iron, perforated with 1-inch round holes. On this was laid a flat piece of thin steel plate, perforated to register with the strip below. The movement of these plates by small bars passing through the walls was intended to regulate the secondary air. The only bad thing about this idea was that it did not work. In practice we found that leakage alone was almost enough to give all the air required. Just above these slides were placed atmospheric burners of 2-inch pipe, with double rows of $\frac{3}{32}$ inch holes. On each side of the burner a strip of sheet iron projected from the walls of the flue to within about $\frac{1}{4}$ inch of the burner holes, to direct the secondary air close to the flames. Cast iron baffles were laid on the brick work about 3 inches above the burners in order to make them light easier, and to keep out dirt. Gas was supplied from a 300-foot run of 4-inch pipe, which had originally been put in to supply a gas engine. This did not give sufficent pressure at the maximum consumption of the burners, but for fear of inconveniencing building operations the pipe was not changed; instead, a small booster was inserted, giving with no load about 6 inches pressure at the oven manifold.

The oven was then heated for two days to warm up the brickwork and a trial baking made. It was successful from the first—not that everything was perfect, but only minor troubles were encountered. The maximum consumption was 3,500 cubic feet per hour, used for 20 to 30 minutes to warm up in the morning; the rest of the day about 2,200 cubic feet was sufficient. The daily average consumption was about 22,000 cubic feet, as compared with 1,700 pounds of hard coal at about $7 per ton. The dimensions of the oven were: Width, 12 feet; depth, 15 feet 9 inches; height, 21 feet; and its capacity for baking soda biscuits was 5 barrels of dough per hour. The water evaporating efficiency with gas was about 50 per cent. At the comparative prices of coal and gas, the fuel cost with gas was about 100 percent higher than with coal. This was considered satisfactory by the biscuit company, so we were ordered to make the installation permanent, which was done by simply going over the work, making everything secure and durable. In addition the stem of the main gas valve was extended through the floor so that the baker could regulate the consumption without going down stairs.

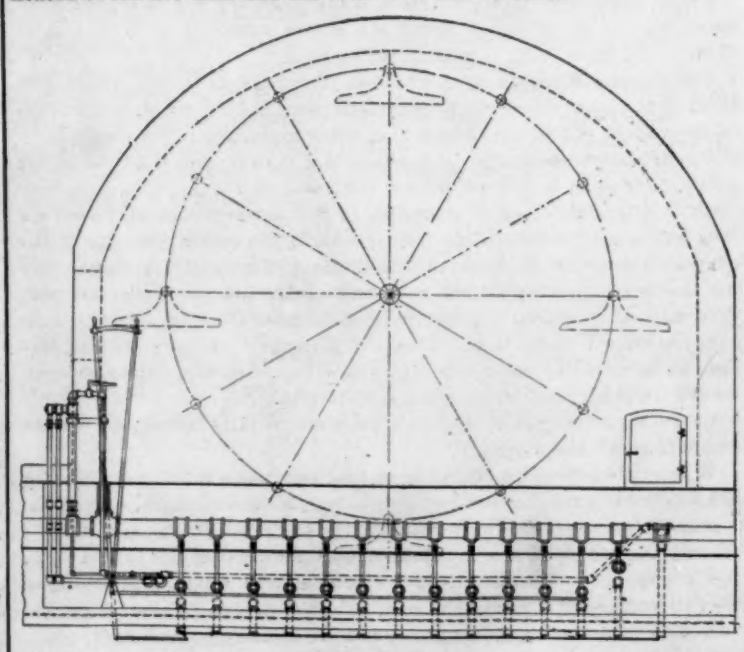
The next order was to equip the largest oven, having these dimensions—width 16 ft. 7 in.; depth 16 ft. 5 in.; height 21 ft. This was done about the same way as the first one with the exception, that in addition to gas regulation being provided for on the baking floor arrangements were made to regulate both the primary and secondary air. The perforated strip idea of controlling the secondary air was abandoned, and dampers placed on the ends of the flues outside of the oven. The two rear burners were elevated somewhat, and the consumption on them greatly increased, one being made of 4 in. pipe with 4 rows of holes, to give a greater top heat in the oven without increasing the consumption on all burners.



PLAN.

FRONT ELEVATION.

To be frank, we had considerably more difficulty in pleasing the biscuit company with this installation than with the first one, as by this time the first flush of enthusiasm had disappeared and a somewhat more critical disposition was apparent. However, we finally got it to suit them, and the two ovens have been running for several months, giving—as far as we can learn—satisfaction. The most pleasing thing from our standpoint is that in slack times the gas heated ovens are used and the coal fired ones left idle.



END ELEVATION.

Our customer then decided to equip the whole plant for gas. This, of course., must be done gradually, so as not to interfere with the business. The company is building a large six-story addition to the plant, with six ovens on the top floor. These ovens are now built. The equipment of them is the most modern in every respect, no expense being spared. They are constructed to use gas exclusively, and coal could not be burned in them without extensive alterations.

In five of them the gas fitting is partly done, and the sixth is now ready for operation. The four remaining old coal burning ovens will not be converted into gas until the new plant is in operation.

The gas equipment of the new ovens we believe to be quite an improvement, as nearly everything can be seen and operated from the baking floor. Of course the burners have to be lower than the floor, but this has been taken care of by having the manifold, mixers, etc., in a pit at the side of the oven. They are lighted by means of a pilot, being started and regulated from the usual position occupied by the baker in charge, the regulation of both primary and secondary air being taken care of from the same position. There are also two side burners operated at this point, but these are required only in case the oven should be a little uneaven in heating. Provision is made for controlling the heat from side to side, front to back and top and bottom. The oven is also equipped with a 4-inch vertical rotary meter in order to check up the baker. A pressure gauge is placed on the burner side of the main valve, and the baker watches this and a pyrometer beside it. After a little experience he soon learns what pressure is required to give the necessary temperature. The maximum consumption of this oven is about 5,000 cubic feet per hour.

The six new ovens are placed in two groups of three, each supplied from a 6-inch riser and a 6-inch service. An 8-inch service and riser has been laid in to supply the six old coal burning ovens.

As the new factory was started before it was decided to use gas, no provision was made for a meter room, so this made somewhat of a problem, but two small spaces were finally secured. We had an English manufacturer make for this installation eleven increased capacity meters. Their diaphragms are the same as ordinary 250-light meters, with valves and channels equal to the 500-light size. Under actual test they pass at 3-inch pressure, 5,000 cubic feet per hour each with 1-inch drop. Gas is sold to this company according to our regular schedule.

The only disadvantage of gas for biscuit baking is higher fuel cost. Its advantages are: (*a*) absence of trouble with fuel supply, (*b*) no machinery or labor for handling coal and ashes, (*c*) less labor, (*d*) less heat and discomfort for employees, (*e*) less spoiled material, (*f*) less floor space required, (*g*) increased cleanliness, (*h*) faster work, and (*i*) a more uniform product. *These advantages more than counterbalance quite an increased cost for fuel.*

Our experience has shown that the fuel bill can be easily increased 50 per cent. by a little carelessness in installation or operation. The points we would emphasize are, that for an installation of this kind the secondary air must be cut to a minimum, and the gas pressure must be good. The maximum capacity of the burners should be about double the average consumption in order to flash on the heat in the morning.

Although it would appear that a successful installation has been made we believe there is still a chance to make a considerable improvement in economy, and that the next few years will show important changes.

Discussion.

Chairman Loebell—We all appreciate the paper that Mr. Watson has read. It is a new thing so far as the United States is concerned, for so far as I know, there is not a single bakery baking biscuits with gas. It emphasizes the fact that regardless of the cost of fuel, when we have other factors of advantage we can get the business.

W. K. Eavenson—I am under the impression that the National Biscuit Company, of New York, use gas for baking. I do not think Toronto is the only city doing it. The Sunshine Biscuit Company are building a new factory in Long Island City; they will use more than 30,000,000 cubic feet.

H. E. Watson—I heard that, and before we started this I came down to New York to see the National Biscuit Company's works; but I was told that while they had a plant using gas, they were not baking biscuits with it, but wafers which are made in machines and not in ovens. There may be something else there now, but it would have to have been put in within the last year.

A. L. Palmer—I think Mr. Watson is right; they are baking wafers. I would like to know what kind of biscuits they were that were baked. We are baking Motzoth biscuits by gas here in New York.

H. E. Watson—The principal product of these ovens was a common soda biscuit. They baked other biscuits too, even dog biscuits, but the soda biscuits are 95 per cent. of the product of the oven.

G. M. Karshner—I have always understood that, here in New York, the National Biscuit Company was using gas in the large English automatic baking machines, and that they have a large number of them. It is very difficult to get into their plant or get information from them, but others who have purchased these machines have stated that they were doing this.

H. E. Watson—I dare say you are right, Mr. Karschner; this company of ours is using those machines.

The Lavoisite s of Generating Oxygen.[1]

There are at present four commercial methods of generating oxygen, and probably the users of oxygen are most familiar with bottled oxygen, as produced by the Linde process. Second in volume to the bottled oxygen produced by that process is that made by the decomposition of water, commercially known as electrolytic oxygen. Electrolytic cells are now installed in manufacturing plants, making it possible for them to produce their own oxygen, thereby doing away with the inconvenience incident to the use of bottled oxygen. The production of oxygen from chlorate of potash and manganese dioxide is also well known, and there are several small plants throughout the country. The Lavoisite system, though not so well known, is an older method of producing oxygen than any of the previously mentioned systems. Its introduction into general use has been slow, for the reason that up to a comparatively short time a practical commercial generator had not been designed, and in this respect the Lavoisite process is similar to a great many other chemical processes, the commercial efficieney depending entirely upon a design of apparatus that will carry out the chemical reations in a reliable manner.

Lavoisite, so called in honor of the celebrated chemist Lavoisier, is a specially prepared calcium hypochlorite. When put into solution, and a suitable amount of catalyzer added, and the solution simultaneously heated to 90° C., it rapidly generates oxygen. Tests from plants in operation show the oxygen from Lavoisite to be practically 100 per cent. pure.

In the early days of autogenous welding, the quality of the oxygen was not given much thought, but it soon became evident that the purity of the oxygen was of the greatest importance, as the results obtained with oxygen 1 per cent. impure would show inferiority in the quality of the weld, the time necessary to accomplish the work and the amount of gas used. This is most pronounced in the cutting of steel, where a difference of only a fraction of 1 per cent. will greatly affect the time of cutting and quantity of oxygen used.

The operation of the Lavoisite generator is described in U. S. patent No. 1,031,017, covering the apparatus.

Lavoisite is shipped hermetically in steel drums, holding about 800 pounds. It is charged into tank *B* (Fig. 1). By a loading device for

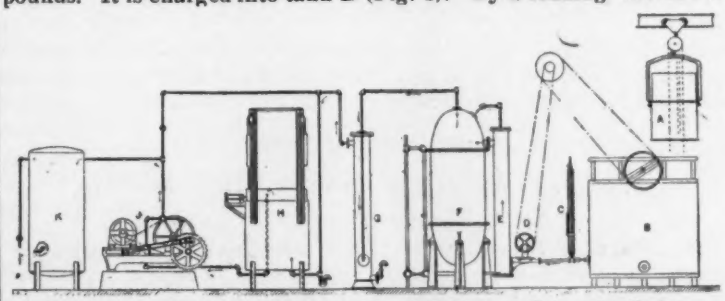


Fig. 1.—Plan and Vertical Section of Lavoisite Oxygen-Generating System.
A, Loader; *B*, Mixing Tank; *C*, Indicator; *D*, Pump; *E*, Heater; *N*, Generator; *G*, Scrubber; *H*, Gas Holder; *J*, Compressor; *K*, Pressure Tank.

lifting the drums from the floor and conveying them to the tank. The loader has doors that open downwards upon releasing a catch, thereby discharging the contents of the drum into the mixing tank. Water is then added to bring the mixture up to the required consistency. An indicator, *C*, shows the quantity of water to be added, according to the weight of Lavoisite placed in the tank. Mixing tank *B* is equipped with an agitating device to assist the Lavoisite in going into solution, and during the generation of oxygen the agitator is kept slowly stirring the contents.

The liquor passes from the mixing tank to the pump, *D*, which forces it into heater, *E*. Connected with pump, *D*, is a small pump for simultaneously forcing catalytic liquor into the heater, *E*, in the correct proportion to liquor pumped by *D*. The heater, *E*, is equipped with a thermostat controlling the live steam admitted to heat the liquor, so that regardless of the speed of the pump, the temperature of the heater remains constant. The Lavoisite and catalytic liquor

1 "Metallurgical and Chemical Engineering."

enter at the bottom of the heater and are brought quickly to 90° C., when oxygen is rapidly generated; it is here necessary that the liquor in the heater travel in the same direction as the liberated oxygen.

About 90 per cent. of the reaction takes place in the heater. The oxygen liberated passes through a pipe from the top of the heater to the generator, *F*; the partly finished liquor passing through a pipe in the side of the heater to the generator, within which the reaction is completed, and the spent liquor overflowing through the pipe shown at the side of the generator. The passage of the liquor through the generator is in reverse direction to that of the oxygen; consequently the liquor that has been unacted upon in the heater, comes into more intimate contact with the catalyzer in the generator, *F*, with the result that the liquor leaving the generator is entirely depleted of its oxygen content.

The oxygen from the generator passes through the scrubber, or cooler, *G*, where it is reduced in temperature, and any moisture mechanically carried over from the generator condensed out. From the scrubber the oxygen passes to a holder, *H*, the bell of which is counterbalanced, the rise and fall of the bell actuating a tank switch, which automatically cuts in and out the compressor, *J*. The pressure on the oxygen up to the compressor is slight, in practice about 2 inches water column. The compressor raises this pressure to any desired point, usually 75 to 100 pounds, and stores the oxygen in the pressure tank, *K*. A pipe from the pressure tank conducts the oxygen to any point where it is desired to use it, the usual reducing valves being placed on outlets from this pipe to reduce the pressure.

The capacity of the Lavoisite generator is very flexible, the quantity of oxygen produced being controlled by the speed of the pump *D*, which is fitted with a cone pulley, making it possible to generate oxygen at from 50 cubic feet per hour to 500 cubic feet per hour. This is of great advantage as it enables the user to keep pace with his work by simply speeding up the apparatus, doing away with the necessity of having numerous tanks of oxygen under high pressure.

The purity of Lavoisite oxygen is such, that in cutting metals it is not necessary to run the pressure above 50 pounds for ordinary work. It is possible to place in a building 11 feet square a generator capable of producing 500 cubic feet of oxygen per hour.

The operation of the generator is automatic and continuous. so long as it is supplied with liquor from the mixing tank, and the tank can be charged from time to time without affecting the generator. In shutting down it is necessary only to stop the feed pump *D*, when the generation of oxygen ceases.

Lavoisite is noncombustible, so that large quantities can be stored without danger, this makes it possible for the user to have a supply of oxygen in a convenient form to meet the varying demands of his needs.

Lavoisite is sold under an agreement with the purchaser that a pound will produce 1 cubic foot of oxygen, when used in a generator designed for its use and operated according to instructions.

French Trials of Coal Stored Under Water.

M. Rolland D'Estape, before the Société Technique du Gaz, described some of his experiences with stored coal. The coal was stored for some months under water and then put into use. The storage bin used had a capacity of 3,200 tons of coal; was cylindrical and built of reinforced concrete, above ground with pipes for drawing off water and a door at the ground level for taking out coal. It was filled to two-thirds of its height with r.o.m. coal, and the remaining third filled up, in three areas, with coal containing about 40 per cent. of small coal, with screened coal, and with large nut.

Tests showed that coal absorbed very little water; not more than 0.7 per cent. in 20 days for the fine coal. The quantity of water adhering superficially varied very much; being with small coal 15 to 20 per cent.; 2 to 3 per cent. for pea and 1.5 per cent. for nut. Simple draining-off is a very ineffective way of drying the coal. After the bulk of the water was drawn off, water continued to drain off the coal at the rate of about 3.6 gallons per minute. Draining continued for a long time, and at the end of 2 weeks was 0.11 gallon per minute. Eighty hours after the drawing off of water was begun, 20 tons of r.o.m. coal was taken off the top, containing 9.8 per cent. of water. It was delivered to the conveyors exactly as is fresh coal from the boats, and when it reached the retort house it contained 6.2 per cent. of water. There was no special difficulty in handling it, although it was somewhat unwilling to move and had to be helped on with a tool. In about 5 hours it reached the retorts, and worked perfectly in the charging machines, both De Brouwer and Sautter, and the retorts filled evenly.

This experience made it evident that there would be no difficulty with the screened coal or the large nut. The screened coal was only a little slow. It started with 6.8 per cent. of water and arrived with 5.0 per cent.; the large nut started with 3.6 and arrived with 2.8. After 6 hours in the charging barrows the r.o.m. coal was found to remain practically at 6.2 per cent. of water, the screened coal at 4.6, and the large nut at 2.0.

The coal from the bottom of the bin was taken out 7½ days after drawing off the water and 420 tons of it sent to the retorts, exactly as if it were fresh coal. It started with 8·8 per cent. of water and reached the retort house with 5 per cent. After 10½ days the water in the remaining coal was 6·2 per cent. and 120 tons of it sent up directly by the lifts arrived with 5·2 per cent. of water.

The 600 tons treated during the tests produced no appreciable cooling of the benches, but longer use of wet coal would assuredly cause cooling, so that either the producers must be forced or the charges reduced, for the 6 per cest. of water would have to be evaporated. The number of heat units used would have to be raised about 4½ per cent.

It seems, therefore, possible to use coal stored under water three or four days after drawing off of the water is begun; and after handling by the conveyors the coal arrives dry enough to be carbonized without inconvenience, and without taking any other precaution than slightly pushing the producers or reducing the charges.

Relative Cost of Coke, Oil and Gas for Melting Non-Ferrous Metals.

Some tests made at the Sheffield University to ascertain the relative merits of coke, oil and gas as fuels for melting non-ferrous metals, are reported in the *Mechanical Engineer* by Prof. J. O. Arnold. The results given in the accompanying table, are based on a run of 14 hours, involving an aggregate weight of brass of nearly one ton, and show a strong prima facie case for the use of gas as a fuel for melting. It will be noted that the cost of gas per 100 lb. melt was 42 cents lower than that of coke, due to the low price of gas in Sheffield. The cost of oil renders the use of this fuel prohibitive, though it possesses an outstanding value for the purity of the product as regards sulphur. The question of oxidation has not been dealt with, but experiments are being made of the relative merits of the three systems of melting in this particular. The coke furnace is of the ordinary type found in shops, having a capacity of 90 pounds pots; the oil furnace is of similar capacity, with air under a pressure of about ¾ pound per square inch; the gas furnace has a capacity of 7 0 pounds pots. With regard to the gas and oil furnaces, it is pointed out that the smaller pot used for 30 pounds does not give the maximum good result possible to be obtained, as a certain amount of heat is wasted in using the smaller pots.

	Coke.	Oil.	Gas.
Output on 14 hour run (total 2,220 lbs. brass), lb	720	750*a*	759*a*
Weight of charge, lb	30	30	30
Number of casts	24	25*b*	25*b*
Time taken for melting initial 30 lbs. charge, starting cold furnace, min.	89	70*c*	78
Time taken for melting subsequent charges, minimum	22	20	19*d*
Time taken for melting subsequent charges, maximum	37	41	34
Time taken for melting subsequent charges, average	29	29	27
Fuel, cost of	$5.76 per ton.	$19.20 per ton.	24c. per 1,000 cu. ft.
Fuel (heat value) British Thermal Units	12,960 per lb.	19,700 per lb.	570 per cu. ft.
Consumption of fuel per 100 lbs. of brass melted	66 lbs.	4.1 gal.	383 cu. ft.
Cost of fuel per 100 lbs. of brass casting	$0.172	$0.306	$0.076
Electrical energy for blast at 2 sents per unit	Nil	$0.066	$0.022

	Coke.	Oil.	Gas.
Cost of graphite crucibles (on a basis of a 48 heat life)	$0.05	$0.066	$0.066
Total cost of melting 100 lbs. brass	0.222	0.438	0.164c
Zinc loss on 100 lbs. brass	0.40	0.85	0.44
	per cent. *f*	per cent.	per cent.
Sulphur (absorbed from fuel) per cent. per cast	0.0040	0.0010*g*	0.0026

a. Oil and gas, although working to a disadvantage in the small charges used, secured greater outputs.

b. These, with increased facilities, would probably have reached 27.

c. The heating from "dead cold" to first cast shows an advantage to the oil furnace.

d. Gas shows the lowest minimum for any 30 lb. charge, viz., 19 minutes from charging to pouring.

e. This shows a distinct saving in favor of gas; the relation being —gas, 100; coke, 135; oil, 267.

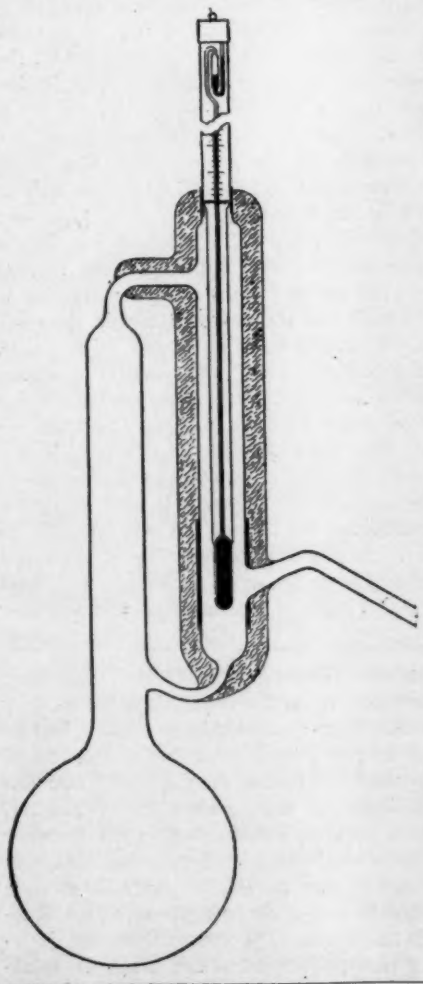
f. Coke melting, with special care, shows the lowest zinc loss (0.4 per cent.).

g. Oil melting yielded the purest product (sulphur content). This would vary with the type of oil used.

A Form of Still for the Exact Measurement of Boiling Point During Fractional Distillation.[1]

By Theodore W. Richards and Frederick Barry.

In the course of a recent investigation on the heats of combustion of liquid hydrocarbons, it was needful to prepare certain of these substances in a very high degree of purity, and in considerable quantity. For this it was necessary to determine exact boiling points, and an advantageous form of still was devised, which proved itself, especially in this respect, more efficient than any of the apparatus now in common use. This still, because of its simplicity and usefulness, and because it does not appear to have been proposed before, seems to the authors to merit separate brief description. A glance will show the immediate purpose of the device. The still was designed to hold a sensitive Beckmann thermometer, so that very small fluctuations in the boiling point of the liquid under examination could be accurately observed, and the boiling point of the purest distillate precisely determined by a comparison with a standard vapor of neighboring known boiling point. The still not only served this purpose admirably, but proved itself a very effective instrument for fractionation.



It consists essentially of a flask of any desired capacity within practicable limits. to which a side tube is attached, the latter being held parallel to the neck of the flask, and connected to it by smaller tubes at the top and bottom. The upper of these, which serves to carry the outgoing vapor, communicates directly with the upper end of the flask-neck, while the lower tube, which serves to return the prematurely condensed liquid to the flask, is a constricted continuation of the side tube itself, and is bent into a shallow U, fused into the flask-neck a few centimeters above the hulb. The relative positions and sizes of these tubes are shown in the drawing. The lower connecting U-tube should be very narrow in diameter, and bent in such a way that the orifice at the flask neck is not much more than the tube's diameter above its lowest point, so as to minimize the amount of dead space which can hold and thereby waste the liquid being distilled.

The vertical side tube is left open at the top, where it is constricted to such a diameter that it will receive and hold closely the shell of the Beckmann thermometer at a point near the zero mark. No cork should be used, the thermometer may easily be made to fit without grinding closely enough to prevent the escape of vapor, for a liquid seal will collect in the annular space at this point. If necessary, a packing of clean asbestos fiber will make the closure secure. With hygroscopic liquids, of course, the thermometer must be fitted into place with a ground joint. The delivery tube should be wide, and should be bent upward at the point where it leaves the side tube, to cause condensed liquid from the bulb of the thermometer, or from the walls, to flow back into the flask, and not into the condenser. A mirror of tinfoil to prevent radiation may advantageously be bound around the side tube so as to surround the thermometer bulb; and the whole of this tube as well as the upper connecting tube should be encased in a thick shell of asbestos.

When liquid is boiled in the apparatus, there is, of course, an almost complete reflux condensation until the tubes reach the temperature of ebullition. In full operation, the distillation should be not rapid, but very steady. All that condenses before the delivery tube is reached returns to the flask through the lower connecting tube, and only that part which still remains as vapor after the long journey passes out into the condenser. No stream of superheated vapor can rise around the thermometer, nor direct spatterings from the liquid impinge upon it. When the tubes are well insulated thermally, the irregular motions imparted to the vapor-stream by the shape of the tubes seem to be sufficient to render the vapor thermally homogeneous when it reaches the thermometer bulb. Here the presence of both vapor and liquid in approximate equilibrium enables the temperature at the moment of egress into the condenser to be accurately determined.

The essential feature of the apparatus is the fact that in it the whole uncertain stem of the thermometer, practically up to the zero of the Beckmann scale, is kept really at the temperature of the vapor. The importance of this precaution in determining any exact temperature with the Beckmann thermometer can hardly be overestimated. The degree of uncertainty introduced by a merely partial heating of the lower tube of this instrument may be very great. Moreover, the bulb of the thermometer is exactly opposite the exit tube into the condenser, so that the thermometer indicates the true temperature of the vapor which is actually being condensed, as nearly as possible. In these respects it is very different from the Claisen form.

When liquids are to be distilled which leave much insoluble residue, another stopper on the neck of the flask itself facilitates cleaning, but this is not necessary. Electric heating by an immersed platinum coil is practicable, and, with non-conducting liquids, advantageous. The use of platinum scrap, fragments of porcelain, or the like, to introduce the gaseous phase into the body of the liquid is, of course, advisable; but except in order to prevent violent bumping, such precautions are less necessary than with the simple boiling flask. In our work the flask was usually heated with the naked flame, which gives less trouble from superheating than a more evenly distributed source of heat of lower temperature. To prevent irregular cooling from the outside, especially when high-boiling liquids were being distilled, the whole still, together with the burner beneath, was enclosed in a cylindrical asbestos box, or air-bath, through which only the outlet tube and the stem of the thermometer protruded. By proper manipulation of the flame, or with the help of a second lamp, the whole system could be kept at a sufficient constant temperature, while through a mica window in the protecting jacket the boiling liquid could be watched.

An example of the progress of a typical case will show the efficiency of the apparatus. Five hundred cubic centimeters of a good commercial toluene were fractionated, six fractions being collected in each distillation, and each of these fractions distributed into six others in the following. After six such complete distillations, the final product, 130 cc. in volume, redistilled within an interval of 0.02°, although the original range of boiling point was at least fifty

(*Continued on page* 106.)

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NEW YORK, MONDAY, AUGUST 17, 1914.

[Official Notice.]

Michigan Gas Association Meeting.

Office of the Secretary-Treasurer,
Grand Rapids, Mich., June 29, 1914.

The annual meeting of the Michigan Gas Association will be held at Lake Harbor, Wednesday, Thursday and Friday, September 2, 3 and 4. This decision has just been made by the Executive Committee of the Association and we are sure those attending the meeting will find this departure from the regular practice of holding gas association meetings in the large cities, a most delightful experience.

Lake Harbor is a resort beautifully located on Lake Michigan and an inland lake 4 miles south of Muskegon, Mich. It is reached by Goodrich Boat Line via Muskegon, and by the Grand Rapids and Indiana Railway, and the Grand Rapids-Muskegon Electric Road via Grand Rapids. The hotel accommodates 500 guests, is prettily located and gives excellent service. There is a fine 18 hole golf course, baseball grounds, 9 tennis courts, Lake Michigan bathing beach, fine bath houses, bowling alley, billiards, canoeing and good automobile roads. There is a combination theater and convention hall which may be used for dancing parties as well as for the business sessions of the convention.

There are a number of cottages in connection with the hotel, and it is hoped that members will bring their wives and children, for the resort specially caters to the whole family.

At the time chosen, the association will have the resort practically to itself, and there is enough to do aside from a carefully planned business programme, which will be announced later, to make the trip worth while to any gas man within reachable distance of Michigan. Every gas man is invited to meet with us whether a member of the association or not. The hotel rates are on the American plan ranging from $3 a day without bath, to $4 and $5 a day with bath; and will for this occasion cover the use of the golf course, tennis courts and other features for which there is usually an additional charge. Glenn R. Chamberlain, Secy. Treas.

BRIEFLY TOLD.

A Severe Arraignment of Expert Testimony.—The California Railroad Commission has rendered a decision denying the application of the Coast Valleys Gas and Electric Company for a rehearing in the case of the complaint of the City of Monterey. The city charged that the company's gas rates were unreasonable and the Commission rendered a decision on June 30, 1914, in which it reduced the top rate charged for gas from $1.50 to $1.30. Engineers employed by the company estimated the reproduction cost of the property at $263,103.89, while the figures arrived at by the Commission's engineers was almost $150,000 less. In its decision the Commission said that if such widely different results can be reached by competent engineers dealing with the same subject matter, the value of engineering aid in rate fixing is much over-estimated, or else one or the other of the engineers where such widely different results are obtained is mentally dishonest. In its application for rehearing the company, among other things, naturally voiced its objection to this statement. In reply to the company's objection the decision rendered by the Commission says:

"The Commission used the language therein found advisedly and used the mildest term that seems applicable to such a case when it designated as mental dishonesty the practice of engineers in attempting to affect values by every conceivable addition that can be thought of through the means of multifarous intangibles. I reiterate the statement made in the previous opinion that the valuation presented in this case does violate the principles of consistency, and while I regret that such language should wound the feelings of anyone, still I believe that this Commission is in duty bound to call attention to the tendency on the part of public utility engineers, acting as witnesses, invariably to exaggerate their values. * * * I cannot see why a public tribunal should be criticised merely because of the fact that it is awake to a program that is being conceived and carried forward before its very eyes. That there is a program on the part of large financial concerns interested in public utility securities, particularly in the stock of public utilities for which ordinarily no money has been paid, to exaggerate the value of the property of the utilities, in my opinion, admits of no doubt. That their procedure is but natural makes it none the less necessary for public authority to be on its guard."

The tendency to which the Commissioner refers undoubtedly exists, and is the product of the policy, too often followed, of claiming everything and taking what you can get. This policy has, however, been forced in many instances by the outrageously inadequate values put upon properties by the few so-called experts that make a business of the municipal side of rate controversies. The case in question seems to be abnormal in the percentage difference between the valuations and perhaps warranted the strictures quoted.

What a Thousand Cubic Feet of Gas Will Do.—An enterprising western gas company has contributed the following to a local paper as a news item of general interest, and an educating hint to gas consumers: "Most people have no idea of the size or the possibilities contained in a thousand cubic feet of gas. Imagine a box 10 feet long, 10 feet wide and 10 feet high, a box that would be nearly as large as an ordinary bedroom. Such a box would hold just 1,000 cubic feet of gas. Quite a package for the price charged, delivery included. The quantity of work that a thousand feet of gas will do is surprising. Check up a few of the following items with your own experience: In the average home of from 6 to 8 rooms, 1,000 feet of gas will do the cooking for one month; will light the home for one month; or will maintain an ever ready supply of hot water for 10 days. In zero weather it will maintain the temperature in the same home at 70° F. for 10 hours. If the home is equipped with a still, 1,000 feet of gas will supply 140 gallons of pure drinking water. Used in the proper kind of an ice machine, it will keep the icebox dry and cold for 6 days. Of course, these figures are based upon the use of gas in efficient appliances. The work of gas in the factory is still more surprising. It will supply a 10-horse power gas engine for 10 hours, or a 100-horse power engine for 1 hour. It will supply a 25-horse power high pressure boiler for 1 hour. It will melt 350 to 400 pounds of brass in 1 hour. In the newspaper office, a thousand feet of gas, if used in an intertype or linotype machine, will heat sufficient type metal to set 130,000 lines of type such as you are now reading."

Abuse of Leaders in Business.—The remarks of Mr. Cortelyou addressed to a gathering of business men the other day, are timely and very much to the point. Mr. Cortelyou speaks not as a Democrat nor as a Republican, but as the President of the Consolidated Gas Company, one of the greatest industries in this city, and his views reflect the opinions of business men generally. What Mr. Cortelyou particularly protested is the spirit rampant in the country to day, which regards all business dealings with distrust and the men of enterprise who are at the head of our railroads, gas and electric light companies, steamships, banks and other enterprises, as malefactors. Much of this mischief is the result of a commercialized journalism in magazines and daily newspapers, in which truth is sacrificed for sensation, the object being to build up their circulation.

These false guides of the masses are pursuing with respect to business men the same tactics that they employ toward the politicians. Just as they see only the seamy side of political life, they have eyes only for the abuses of concentrated wealth. The people in government, as well as in business, must have leadership, and unless one is ready to subscribe to the doctrines of the Commune, which exalt the proletariat over the educated classes, the hands of those who rise to leadership either in politics or business must be upheld. Once you destroy authority disintegration enters and society becomes demoralized. This is precisely what has happened in this country, and is the cause of business and political demoralization. The best men in the great political parties have withdrawn from public life, because of the press persecution to which leaders are subjected, and the governing class is now composed mainly of adventurers who talk the new jargon made fashionable by the muckraking magazines and newspapers. Business leadership will be pulled down in the same fashion unless a halt is called; men of first-rate ability, who have made this country what it is, will follow the example of the great political leaders and abstain from entering a field in which they can count only on abuse. Weaker men will take their places and the commercial supremacy of this country will be a thing of the past.

CONSOLIDATION TO HELP SMALLER TOWNS.—The Second District, New York, Public Service Commission has authorized a reorganization and consolidation of electric and gas companies in Rockland County, which will have a far-reaching effect in the improvement and extension of gas and electric service along the west shore of the Hudson and in towns in Northern New Jersey. The Rockland Light and Power Company is authorized to issue $463,000 of capital stock, the proceeds of which will be used to purchase the Rockland Electric Company, and certain outstanding notes of the latter concern, as well as to cover certain unfunded debt of the former company, and to acquire controlling stock in the Rockland Electric Company of New Jersey. Thus reorganized, according to the opinion of Commissioner Martin S. Decker, on which the case was decided, the property will be in a far stronger financial condition, both as concerns its present operations and as to future betterments.

The companies authorized to consolidate, while serving adjacent territory, are not in any sense competing. A territory of nearly 200 square miles will be served by the new organization, affording large additional facilities of growing industries along the lines of the several railroads running through this section and for the large residental developments. Improvements to plant and service will be provided for out of issues of new stock. The consolidation, in addition to providing a firmer financial basis for the corporations, will also result in savings in operating expenses. The generating plants of the two New York State companies, at Orangeburg and Hillburn, will be connected by a transmission line and operated in conjunction with one another. The Hillburn plant, which will become the main generating station for the system, will be largely extended, the Orangeburg plant being maintained as an auxiliary.

Among the communities to be affected by the merger are the villages of Haverstraw, West Haverstraw, Spring Valley, Nyack, Upper Nyack, Grand View, the towns of Stony Point, Haverstraw, Ramapo, Clarkstown, Orangetown, and the unincorporated village of Thiolls. In New Jersey the improvements will affect Hillburn, Tallman, Hohokus, Orvil, Franklin, Mahwah, Wykoff, Ramsey, Alandale, Cragmere, Saddle River and Upper Saddle River.

The Commission, in its order, provides for a careful system, whereby the tangible fixed capital of the companies will be reduced and the intangible amortized.

NO USE FOR GAS IN 1924.—One outcome of the long continued fight over gas rates in St. Paul, Minn., was a similar demand in the sister city of Minneapolis, which has been answered by a voluntary reduction in price on the part of the Minneapolis Gas Light Company. This seems, however, only to have whetted the appetites of the agitators, and a proposition is now before the city council to acquire the gas plant for the municipality. In discussing the question in a council session, Alderman John Peterson opposed the proposition of takover the property of the Minneapolis Gas Light Company because: "In the last 5 years electricity has taken rapid steps forward," Ald. Peterson said: "Even now they are using electric current for fuel. You find electric stoves and other utensils in nearly every household. In 10 years we will have forgotten how to use gas. It would be a big mistake for the city to take over the gas plant at this time. In a few years it would be an elephant on our hands. We couldn't cheapen the price of gas if we did take over the plant, and that's the only excuse we could possibly have for taking such action.'

Look at the three parallel statements:

The gas company must reduce its rates because it is earning too large a return on the capital invested.

The city could not furnish gas cheaper than the company does.

In 10 years we will have forgotten how to use gas, and the plant will be of no value. What is the answer?

WINDOW DISPLAYS.—The N. C. G. A. is sending to its company members this letter as of August 10th:

DEAR SIR: We send you, under separate cover, a reproduction of two pages in the August issue of our Bulletin, together with colored window pasters described in the two window displays.

We would ask you to kindly turn over to the man who has charge of your window trimming the reproduced article from the Bulletin, together with the colored pasters, as we believe they will be of considerable assistance to him in planning window displays similar to those described, and which have been used to good advantage by one of the large eastern companies having a number of district offices.

We would be pleased to have an expression of opinion from you as to the value of this service, which is free to your company, and which we propose continuing if we find that companies generally are receiving benefit from it. Will you also advise us whether you will trim your windows in accordance with the suggestions offered?

We would also ask you to kindly send us, from time to time, photographs, sketches or plans of any window displays which you have used and found profitable, and also any suggestions which your employees may have to offer for window trimming.

We think we can make this section of the Bulletin and this window trimming service valuable to your company, and any suggestions you may have to offer will be carefully considered by the Committee. With kindest regards, I am, yours very truly,

LOUIS STOTZ, Secretary.

This marks the inauguration of another free service for company members of the National Commercial Gas Association that it is believed will be of great value to them. Members are urged to assist the Window Display Committee by sending them plans of window displays, or descriptions from which plans can be made. It is believed that very many good ideas can be gotten from the members, and the idea is to make them available for all.

EDUCATE THE CONSUMER.—We recommend the following article as a bill sticker or special letter to consumers:

"We all know that the size of the bill can easily be doubled by careless management of the stove, but how many women know that even a moderate gas bill may be materially reduced by a little thoughtfulness. In the first place every woman should know how many cents' worth of gas each burner in her stove consumes an hour, so she will know exactly how much she saves by use of the fireless cooker, or how much her bill is cut down by the use of the smaller burners and simmerer; in other words, this exact knowledge is indispensable if she expects to use her range with the utmost economy. It is impossible to give figures here as gas rates differ so widely, but the gas companies in any city will furnish the information about their stoves. Another point to be considered is the scientific use of utensils. To waste least heat, broad, shallow utensils should be used, as they make the greatest use of the heating surface on which they rest. Steamers are great fuel savers, as steam saves loss of heat by evaporation. Incidentally many vegetables are better steamed than boiled, for steaming allows less waste of juice and flavor.

"Oven doors with glass in them are indispensable to economy, as opening and shutting the door to find out whether the food is cooked allows a great deal of heat to escape. Of course, only the newest ranges have this convenience, but there are excellent portable ovens for sale that have windows in the side.

"Double roasting pans and double pots for one burner are found in almost every kitchen, but the teakettle with the double boiler inset is not so widely known, and it is especially useful for cooking cereals.

"Then there is a little device for utilizing one burner as an oven that is an economy when only a small quantity of food is to be baked. It is a little attachment that sets over the burner with a hood to cover it and exclude the air.

"The fireless cooker, which, of course, heads the list of fuel savers, has already been given its share of attention, but some of these other devices are not as well known, for although they are found in all the large shops, the housewife is often doubtful of the efficiency of modern utensils and turns to the old type she has seen in her mother's and grandmother's kitchens. Conservatism is a mistake, for it must be remembered that we have changed the methods of cooking as well as the pots and pans."

(*Continued from page* 103.)

times as great. Two more fractionations of a half of this material yielded 40 cc. of a product which distilled within a range of less than 0.01° under barometric pressure constant during the time of distillation; and very nearly all of this purer material redistilled over the same range. By immediate immersion of the warm dry bulb of the standardized Beckmann thermometer (which had a range of 2°) into a carefully regulated steam bath, the difference between the two boiling points of toluene and water was thus measured, and the boiling point of the toluene determined to within 0.01°.

Although no claim is made that this still is more efficient than some of the other forms, it is seen to possess advantages with regard to exact thermometry not possessed by any other usual form. Moreover, stills of this type will be found to be not only sufficiently effective in operation (as is evidenced by the data just quoted), but also convenient in use. They are not complicated in design, and therefore inexpensive; they are not cumbersome, and are easy to handle. If properly made they are by no means fragile, and will not crack at the joints if they are gradually heated with ordinary precaution and no cold liquid is put into them while hot. Made of Jena glass, they are very resistant to fracture by irregular heating; made of silica, they can be used at high temperatures still more safely; and they may be used with resistance thermometers if desired. They can easily be cleaned and are much more practicable than some of the more complicated still heads. Distillations from this apparatus are also accompanied by little loss, because the surface of condensation is small, and the liquid retained by the U-tube may be reduced to a very slight amount by constricting its diameter. But the most important object of the apparatus, as already stated, is the exact determination of the boiling point of the actual distillate.

Coal and the Chemistry of its Carbonization.

[Abstract of a paper by Mr. John Harger, read before the Liverpool Section, Society of Chemical Industry.]

Very little is known of the chemical compositions of the various constituents of coals, though some progress has been made in separating them by the solvent action of pyridine, discovered by Professor Bedson. Coals, such as anthracite, semi-anthracite and steam coals, yield very little pyridine-soluble matter, neither do brown coals nor cannals yield very much, but some bituminous coals give as much as 40 per cent. extract. The utility of the pyridine extraction method is, however, impaired by the facts that the ultimate chemical analysis of the soluble and insoluble portions from the same bituminous coal differ very little, and that, up to now, all the fractions contain more nitrogen than the original coal, indicating that some pyridine, in spite of all precautions to remove it, is retained by the coal substances. By the usual Soxhlet method the quantity slowly dissolved by pyridine is large at first, then more is dissolved very slowly, an extraction usually extending over two weeks at least. The author has found that a better way is to take a small quantity of the finely powdered coal (passing through 120 mesh sieve), say, about 1 gramme, add 150 grammes of pyridine, seal in a strong glass tube and heat to about 160–180° C. for 24 hours. By this method more extract is obtained in 24 hours than by the usual method in months.

The chemists at the Government Experimental Station have found that the inflammability of coal dust is in proportion to the quantity soluble in pyridine. The French Government chemists, however, find that, for French coals at least, this relation does not apply. The author has found that cannal coal contains very much less soluble in pyridine than ordinary bituminous coals, by the Soxhlet method. Old Roundwood cannel yields 15½ per cent., and Lancashire Arley coal 22½ per cent., yet there is no doubt that the cannel dust is far more inflammable than the dust of the Arley coal. It was found, however, that Arley coal dust, which gave only 22½ per cent. soluble in pyridine by two weeks' extraction in the Soxhlet, gave 40½ per cent. soluble in pyridine by the sealed-tube method. 150 grammes of a different sample of Arley coal, but taken from the same mine, was extracted first by chloroform and then by several portions of pyridine, boiling up in each case for long time until only a trace of soluble matter was obtained. A portion of the residue was then taken and heated in a sealed tube for 34 hours at 160–180° C., and the residue from this heated with a fresh portion of pyridine for 24 hours at 160–180° C., with the following results, stated on the dry and ash-free substance.

Some of these fractions were saturated with chlorine, after removal of pyridine, etc., in a current of inert gas at 150° C., and the increase in weight is stated below. Chlorine and hydrochloric acid were removed *in vacuo* over sodium hydroxide. Increase in weight, per cent., Fraction B, 74.4; C, 64.4; E, 55.7; F, 31; H, 64.2. A considerable number of experiments have been made on the action of chlorine at high temperatures. CH_3Cl, CH_2Cl_2, $CHCl_3$, CCl_4 and C_2Cl_6 in considerable quantities were obtained.

The fact that pyridine dissolves the so-called resin bodies so very slowly and dissolves much more with the slight increase in temperature by the sealed-tube method, shows that this is not a case of ordinary solution. The extract once obtained is quite readily soluble in pyridine and gives a thick, viscid, tar-like mass, and that it is not "absorbed" by the insoluble portion of coal is shown by examination of thin sections which show the resinous bands and nodules to be separate from the general matrix. There appears to be some kind of simplification in the constitution of the constituents which yield the pyridine soluble matter, a process similar to depolymerisation and due to the action of pyridine and heat. This is similar to the behavior of many ordinary resins which are only soluble in certain solvents after they have been heated at moderately high temperatures for some time. Clark and Wheeler have shown that the pyridine extract from Silkstone coal can be separated into two fractions by the solvent action of chloroform, and the author has found that this is the case with the pyridine extract from Arley coal also. The solution by chloroform is an extremely slow process and requires about two weeks to make the extraction complete. This points to either absorption or depolymerisation. An interesting point is that this chloroform-soluble portion does not appear to be in the original coal as such. There is some portion of Arley coal soluble in chloroform and the quantity seems to vary very much with coal even from the same seam. In one experiment it was as much as 3.9 per cent., but generally it did not exceed 1½ per cent. This substance contained no sulphur and no nitrogen and gave on analysis:—Hydrogen, 8.81 per cent.; carbon, 83.92; oxygen, 7.27. The portion dissolved out of the pyridine extract by chloroform was rather more than ¼ of the total pyridine extract, and this material contained nitrogen and sulphur as well as carbon, hydrogen and oxygen.

In the paper by Clark and Wheeler, results of extraction of Silkstone coal by pyridine, and subsequent action of chloroform on the extract obtained, are given with analysis of the various fractions. From their figures it is evident that all fractions contain more nitrogen than the original coal, and it appears on calculation that pyridine amounting to 4 per cent. on the coal taken has been retained by the fractions. Examination of their figures also shows that in the extraction by pyridine and subsequently by chloroform a considerable quantity of oxygen has been absorbed and some sulphur lost. The figures show that:—(1) 100 parts of coal have retained slightly more than 4 per cent. of pyridine. (2) Oxidation has occurred in both extractions, but especially with chloroform, where the oxygen has increased by nearly 60 per cent. (3) There is a loss in sulphur in both extractions.

It might be gathered from these figures that the absorption of oxygen is an essential feature in the solution of these constituents by pyridine and chloroform, but the fact that more is dissolved by treatment in a sealed tube in absence of air proves that this is not so. The fact that pyridine is retained by the fractions even after heating *in vacuo* at 100° for several days has been proved by heating a portion of pyridine extract in a current of nitrogen at 150° C. The gas which came off contained pyridine, and was passed through H_2SO_4 which is distilled later with potash and the distillate titrated. This experiment showed the presence of 3 7 per cent. of pyridine in the material. Later experiments have shown that the portion insoluble in pyridine contained pyridine after heating *in vacuo* for several days at 100° C., and it has been found much more difficult to remove all the pyridine from the insoluble than from the soluble fractions.

The Coking Problem.—Not every coal gives a satisfactory coke on carbonization. A coal which will coke must contain a certain minimum quantity of bituminous matter. The coals selected for making metallurgical coke contain sufficient bituminous matter to fuse on heating to a few degrees above 310° C. The mass of washed coal is converted on heating to a pasty mass, from which, on further heating, the volatile matters distil, leaving a fixed carbonaceous residue which becomes harder and stronger the higher the temperature employed, because volatile hydrocarbons are decomposed, with deposition of carbon, in proportion to the temperature of the solid ma-

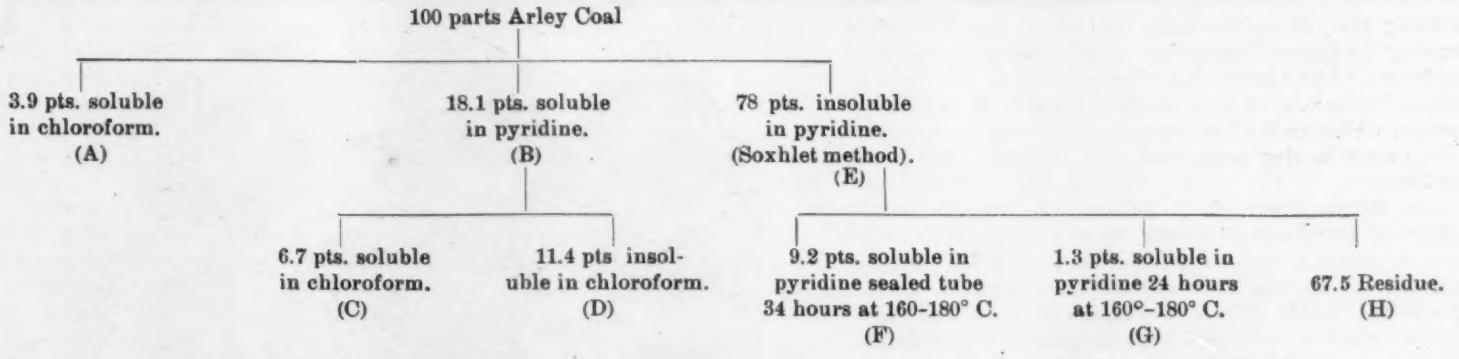

100 parts Arley Coal
3.9 pts. soluble in chloroform. (A)
18.1 pts. soluble in pyridine. (B)
78 pts. insoluble in pyridine. (Soxhlet method). (E)
6.7 pts. soluble in chloroform. (C)
11.4 pts insoluble in chloroform. (D)
9.2 pts. soluble in pyridine sealed tube 34 hours at 160-180° C. (F)
1.3 pts. soluble in pyridine 24 hours at 160°–180° C. (G)
67.5 Residue. (H)

TABLE I.—*Showing Changee During the Separation of Silkstone Coal Fractions, by Clark and Wheeler.*

All Calculated on Ash and Moisture-Free Coals.		A. 100 pts. Original Coal.	B. 80 pts. Insoluble in Pyridine.	C. 20 pts. Soluble in Pyridine.	D. Average of 80 pts. B, 20 pts. C (should equal A).	Diff. + or −	E. 12 pts. C. Insoluble in $CHCl_3$.	F. 8 pts. C. Insoluble in $CHCl_3$.	Average of 12 pts. of E 8. pts. of F (should equal C).	Diff. + or −
Proximate Analysis..	Volatile matter	36.79	34.96	55.24	39.02	+ 2.29	31.88	77.33	50.06	− 5.18
	Fixed carbon	63.27	65.04	44.76	60.98	− 2.29	68.12	22.67	49.94	+ 5.18
Ultimate Analysis.	Carbon	82.92	80.81	82.89	81.26	− 1.66	77.32	85.33	80.52	− 2.37
	Hydrogen	5.58	5.23	7.14	5.61	+ 0.03	5.14	7.08	5.91	− 1.23
	Oxygen	8.45	10.40	6.62	9.64	+ 1.19	14.26	4.56	10.38	+ 3.76
	Nitrogen	1.31	2.14	1.91	2.09	+ 0.74	2.07	1.71	1.92	+ 0.01
	Sulphur	1.70	1.42	1.44	1.42	− 0.28	1.21	1.32	1.25	− 0.19

terial through which these volatile hydrocarbons have to pass. With very high temperatures the product is hard and will withstand considerable pressure.

It appears that the coking properties of coals must be due to some compounds of C, H, O, N and S, about which little further is known than that they melt at about 320° C. Anderson and Roberts showed that coals of the Clyde Basin began to soften at 310° C. and melted fairly completely at 320° C. The best coking coals melted at 317° C. The older coals coked, the newer ones did not.

	Carbon.	Hydrogen.	Oxygen, etc.	Coking Power.
Non-coking	82.65	5.55	10.1	3.9
Semi-coking	83.16	5.48	8.98	4.4
Coking	85.41	5.36	7.22	13.5

It is not possible to tell from the ultimate analysis of a coal whether it will coke, but it is often found possible te say that it will *not* coke. Cases are known of coals of exactly the same ultimate chemical composition some of which coked quite well and the others not at all. An essential part of the process of coking takes place between 250° C. and 400° C. If coking coal is carbonized below 400° C., then powdered and heated to very high temperatures such as are employed in metallurgical coke ovens, there is no sign of sticking together of the particles. It is generally believed that it is the quantity of the so-called resinous constituents in coal which determines its coking or non coking property. According to Anderson this has been proved to be wrong, but on what evidence is not clear. A study of his papers reveals no facts supporting his conclusion.

Some of the fundamental facts about the coking property are:—(1) The coking property in some coals is destroyed by exposure to air, and even in more strongly coking coals it is sensibly diminished. (2) The coking property in some coals is destroyed, in others weakened and in some not affected by boiling with dilute caustic potash. (3) Heating in a current of inert gas at 300° C. for several hours destroys the coking power of some coals and weakens it in all coking coals; but the strongly coking coals retain sufficient to coke when strongly heated.

Anderson and Roberts conclude, and Professor V. B. Lewes agrees that strongly coking coals, in addition to the so-called resin bodies, contain substances which are not soluble in alkali, do not oxidize in warm air, and do not decompose or volatilize at 300° C.; and that substances of this class melt on strongly heating and yield enough luting material to form coke. They call these substances "hydrocarbon bodies." The assumption of the existence in coal of a class of compounds called hydrocarbons, on such evidence, is not, in the author's view, justifiable and they must be omitted from the constituents of coals. (Hydrocarbons have been found only in mere traces in coals.)

The phenomena described above would be observed if the so-called resin and other bodies on slow heating, etc., decomposed and yielded, amongst other products, a *smaller* quantity of substance which was fusible at higher temperature, and this is what the author has found does actually take place. The true coking coals contain sufficient resin-like bodies to yield, after heating at about 300° C., sufficient fusible material to form coke when heated to 320° C. or above. While the feebly coking coals on heating, etc., gave the same kind and proportion of fusible bodies, the quantity was not sufficient to melt or render liquid the whole of the material and so coke could not be formed.

A sample of Arley coal extracted with chloroform gave 1.2 per cent. soluble; on heating another portion of the coal to 230° C. in inert gas for 5 hours it gave on extraction 1.4 per cent. soluble in chloroform. A third portion, heated for 5 hours at 270° C., gave on extraction 7.6 per cent. soluble in chloroform. A fourth portion was alternately heated to 330–340° C. in inert gas, and extracted with chloroform five times; the total time of heating was 22 hours, and the total of the chloroform extracts amounted to 8½ per cent. of the original coal. It is evident that a subtle change starts in Arley coal at about 250° C., and at 270° C. it is very marked, although the coal is changed very slightly in appearance and no permanent gas appears to be evolved. Experiments were made to ascertain which part of the coal gave rise to these products soluble in chloroform. Pyridine extract after heating to 340° C. gave 8.2 per cent., and pyridine residue after similar treatment gave 1.6 per cent. It is therefore evident that both constituents give rise to the products.

Nitrogen in Coal.—There is evidence to show that nitrogen occurs in coal combined in two or more essentially different ways. A small quantity of the total is given off as ammonia on carbonization, whilst half of it remains in the coke, indicating that it occurs in coal combined in at least two ways and probably more. It has been observed that in some coals the nitrogen estimated by the Kjeldahl method is a mere trace, when a Dumas estimation reveals there is about 2 per cent. In other coals the two methods give exactly the same amount, showing that the nitrogen is not held the same way in all coals. It has been further observed that when some coals are mixed with caustic soda and ignited, much less nitrogen remains fixed in the residue of the untreated coal, and it has been observed that other coals, when treated in a similar way with caustic soda, etc., had more of their nitrogen fixed than when heated alone. Some of the fixed nitrogen can be converted into ammonia by passing hydrogen over the red-hot coke, but the only practical method hitherto devised of in-

creasing the yield of ammonia is to burn the coke while keeping the temperature as low as possible, as in the Mond producers. The nitrogen which comes off as ammonia on the carbonization of coal probably exists in side-chain groups, whilst that which remains fixed in the coke probably occurs in ring compounds, the ring being stable at a red heat.

Over 20 years ago R. J. Friswell discovered that by acting on powdered coal with nitric acid of about 50 per cent. strength, a complex organic acid or acids were obtained, which decomposed sodium carbonate with evolution of carbon dioxide. These bodies, which were later called the coal acids by Anderson, are insoluble in water containing much mineral acid, but in pure water or dilute alkali or dilute acid they are soluble, giving an ink-like solution. The solid coal acids on heating with zinc dust gave hydrogen, cyanogen, and a small quantity of aqueous distillate, smelling of ammonia and pyridine, and containing hydrocyanic acid. Anderson worked on compounds made from very different kinds of coals by treating with nitric acid, and found that the resulting coal acids had about the same ultimate chemical composition. It seemed probable that the nitric acid oxidized all the side-chains, giving COOH groups attached to a nitrogen ring complex. To test this the author oxidized some Arley coal with fuming sulphuric acid (so as to keep nitrogen containing reagents out of the experiments) and obtained similar compounds to those go by Friswell and by Anderson. The solid purified coal acid was mixed with caustic soda and heated. A gas smelling like charred albumen or bone was obtained, and the same was obtained several times on repeating the experiment with fresh quantities of coal. This would appear to indicate that coal contains nitrogen in the form of a ring complex, which on oxidation with fuming sulphuric acid is converted into a carboxylic acridine.

The author then referred to the Coalite process, in which the coal is carbonized at about 650° C, giving a coke not so friable. The yield of sulphate is raised from 12 pounds to 28 pounds; the tar reduced to 18 gallons, and the gas increased to 8,500 cubic feet per ton of an average bituminous coal. He also referred to the low-temperature carbonization *in vacuo*, and pointed out that as much as 80 to 100 gallons of coal oils were obtainable from some cannel coals by this process, a considerable portion of which could be converted into petrol (8 to 10 gallons) and a large proportion of the remainder into oils suitable for use in Diesel engines. Another low-temperature carbonization process, the "Del Monte," was briefly mentioned. None of these processes are intended to replace either gas works practice or metallurgical coke ovens, and the author questioned whether, in view of the demand for a smokeless fuel and the great advance in the value of petrol and oil, the modern gas works' practice of obtaining as much gas as possible per ton of coal had not been overdone, and if the old lower temperature of carbonization was not more suitable to present needs.

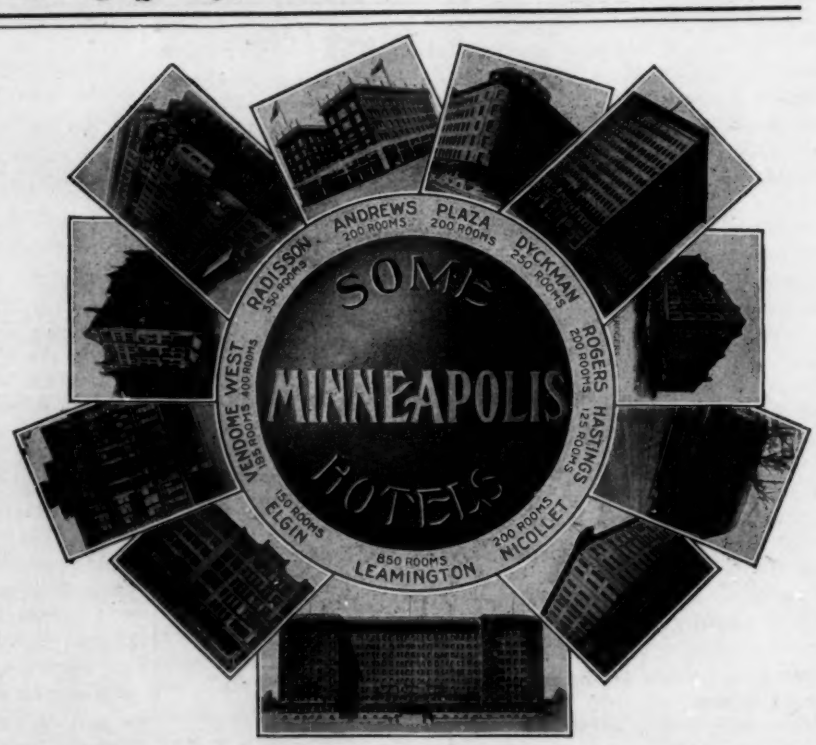
As regards metallurgical coke it was also a question whether this could not be produced in two stages, viz., (1) Carbonization at a sufficiently low temperature to preserve the valuable light oils and give rich gas; and (2) high temperature carbonization to give the finished hard coke and poor gas.

Both the gas-works manager and the coke-oven manager can learn that, under certain conditions, it was not a question of how difficult it was to heat up coal, but how difficult it was to prevent it heating up spontaneously; also that a gob-fire could give a beautiful hard coke with coal which no existing coke-oven could coke at all. Practically any bituminous coal could be coked in favorable circumstances, but ordinary coke-oven processes do not give these favorable conditions.

National Commercial Convention.

Everybody should plan to visit Minneapolis at the time of the convention of the National Commercial Gas Association. Those who have not seen this wonderful "City of Lakes and Gardens" have a treat in store. Some of you who have been victims of the mistaken impression that there is nothing but Indian wigwams and settlers' cabins west of the Mississippi river are going to need pulmotor treatment, because you will find Minneapolis as great a city as any in America, if not as large as some in population; and you are going to find some things in the way of natural beauties which no other city in America can parallel.

Just stop to think of this—a city whose combined manufacturing, jobbing, retail, banking and other business mounts into billions of



dollars annually, which has within its limits four lakes on which there is sailing, canoeing, rowing, skating, iceboating, horse racing on ice, tobogganing, skiing and bob riding, and in which you can catch a half dozen different varieties of fish and large ones, too. And consider also that this city, scarcely more than a half century old, has 107 public libraries, has a symphony orchestra which ranks among the three most famous orchestras of the world, a two million-dollar art museum, a state university with an enrollment of 8,500 students, eighty public schools and a large number of colleges and other institutions, which combine to make it the cultural as well as the commercial center of the great American Northwest. Just for a moment, let this fact run through your mind—that Minneapolis is the gateway to the Northwest, a vast fertile region, exceeding in extent the combined area of France, Germany and Great Britain.

Minneapolis is one of the famous convention cities of America. Our very important convention is only one of a hundred large national gatherings, which have been entertained in Minneapolis within the past 10 years. It is a year-round convention city, and nearly every month has its average of a dozen State and national meetings. It offers to visitors every facility for comfort and amusement to be found in any great metropolitan community, and it has in addition a host of wonderful naturaf charms. Minneapolis is laid out on generous lines. Its streets are wide both in the central business districts and in the residence sections. Clean white buildings abound. It has a climate that has gained for it year after year from the United States Census Bureau authority that it is the most healthful large city in America.

Incidentally those delegates who go to the convention of the National Commercial Gas Association through the Chicago gateway will be treated to the finest passenger-train accommodations in existence. There is no better train service in the world than that between the Twin Cities and Chicago, and it will be but a foretaste of the comforts and conveniences to be enjoyed in Minneapolis.

Synthetic Coal Gas.

In the "Comptes Rendus" of the French Academy of Sciences there is an article by M. Leo Vignon on the synthetic preparation of coal gas, from which the following is translated:

It is possible to gasify the total carbon in coal or coke as producer gas, or water gas, but these gases present numerous inconveniences compared with coal gas, being poisonous and having much lower heating power, as shown by the following figures:

	Per Cent. CO.	Calorific Power per Cubic Metre.
Coal gas	8	5,000 to 5,200
Producer gas	33	900 " 1,000
Water "	50	2,400 " 2,800

I tried to prepare synthetically by the total gasification of the carbon of coal, a combustible gas fulfilling the following conditions: (1) Containing as low as possible percentage of carbon monoxide, at most equal to that in coal gas. (2) Having the greatest possible calorific power, approaching that of coal gas. (3) Having an analogous composition to that of coal gas. I was able to obtain these results by solving certain theoretical problems. I noted that carbon monoxide acting upon lime in presence of water, in specified conditions, was transformed into hydrogen carbides and carbonic acid. Next, a study of the action of steam upon carbon in the presence of lime enabled me to observe that the following reactions could be obtained at 600° to 800° C.:

$$(1)\ C + CaO + 2\ (H_2O) = CO_3\,Ca + 2\ (H_2);$$
$$(2)\ C + CaO + 2\ (H_2O) = CO_3\,Ca + CH_4;$$
$$(3)\ C + CaO + 2\ (H_2O) = CO_3Ca + C_2H_4.$$

My researches were then directed to the composition of water gas. The small proportion of methane it contains originates in the catalytic action of the lime on the coke. Other substances also can act catalytically for the formation of methane—*i. e.*, iron, nickel, copper, silica, alumina and magnesia.

The results summarized below allow of the synthetic preparation of a gas resembling coal gas.

(1) Water gas brought into contact with lime, in presence of a suitable quantity of water, at about 400° C., gives a gas containing 85 to 90 per cent. of hydrogen, 5 to 10 per cent. of methane, and 0.5 per cent. of carbon monoxide; its heating power being about 3,000 calories per cubic metre.

(2) Steam is passed over a mixture of coke and lime heated to 600° to 1,000° C., with the following reaction:

$$(4)\ C + 6\ H_2O = 3\ CO_2 + 4\ H_2 + CH_4$$

Supposing the carbonic acid to have been separated, 100 kilos of coke give 200 to 230 cubic metres (7,000 to 8,000 cubic feet) of gas having the following percentage composition: Hydrogen, 80 to 85; methane, 15 to 20; carbon monoxide, 0.5. The heating value is from 3,500 to 4,000 calories per cubic metre.

(3) Coal mixed with lime and carbonized at 900° to 950° C. gives 25 cubic centimeters of gas (A) per 100 kilos. of coal. This gas is very rich in hydrogen carbides and ammonia. Carbonization being completed, steam (not in excess) is conveyed to the coke, maintained at 900° to 1,000° C. Thus there is obtained altogether, per 100 kilos. of coal, about 200 cubic metres of gas (including gas A), the percentage composition of which, after the deduction of carbonic acid, will be: Hydrogen, 70 to 78; methane, 15 to 20; carbon monoxide, 5 to 10. By suitable regulation of the reaction, the carbon monoxide can be reduced to zero. The heating value is from 4,000 to 4,500 calories.

The quantity of ammonia carried forward by the gas, and which can be collected, is at least four times that usually found, equalling 36 kilos. of sulphate of ammonia per metric ton of coal. It may be supposed that the sulphate formed should be near the theoretical quantity; and 4.7 kilos. corresponding to 1 kilo. of nitrogen, we should have 47 kilos. per metric ton with 1 per cent. of nitrogen, and 94 kilos. per ton with 2 per cent. of nitrogen.

Summary.—The synthetic preparation of coal gas presents, as compared with the old method, the following advantages: (1) It utilizes the coal better and more scientifically. The volume of gas obtained is from eight to ten times greater than that of gas manufactured by simple distillation; and most of the nitrogen in the coal is transformed into ammonia. (2) It produces a non-poisonous gas in which the proportion of carbon monoxide can be reduced to zero.

A Safe Boiler Support.

The importance of safe boiler support is not generally recognized according to an editorial in *Power*. The boiler laws that have been enacted in the various states do not seem to have taken into account its influence as affecting the safe operation of boilers. Anyone familiar with boiler explosions will be sure that if a boiler should fall down while under steam, an explosion would follow; yet it is rare to hear this cause advanced as the explanation of boiler explosions. It seems reasonable to think that many mysterious boiler explosions, occurring with boilers where there is conclusive evidence that no overpressure existed, may have been due to the falling down of the boilers or their changing position enough to result in the breaking of the pipe connections. Conditions surrounding the recent explosion of two boilers seemed to indicate that the falling down of one of the boilers is the only reasonable explanation of the accident. These two boilors exploded almost simultaneously, the first explosion having undoubtedly been the cause of the second. The tears through the shells of both boilers were similar, occurring through the top manhole reinforcement, which was of the outside pattern, and weak. The girth rivets at each end of the course that contained the manhole opening were sheared. All parts of the shell that were fractured were without evidences of defects, the tears being through the solid plate. Calculation showed that the structurs should have stood about five times the load due to the steam pressure that was on the boilers at the time of the accident, and that there was not an excess pressure at the time was clearly indicated by the condition of the top safety valves. One boiler showed distinct marks on the manhole course of having been dented by a blow delivered to it by the manhole frame of the adjoining boiler. From the nature of the breaks it is probable that the main steam connection on one boiler was broken by the falling down or settling of the boiler, and the sudden opening and the resulting outrush of steam, caused a wave action of the water in the boiler, which resulted in its rupture girthwise and the manhole course lengthwise through the manhole rcinforcement.

Massachusetts and Ohio rules prescribe that boilers above 78 inches diameter be hung, and that the support be independent of the setting walls; this provision, evidently made for fear that such large boilers could not be safely supported on the setting. It would seem a reasonable precaution to have all sizes of horizontal tubular boilers hung. Smaller size boilers are usually installed in plants where the condition of the setting is not as apt to be so closely watched, and small boilers for this reason are probably more likely to be exposed to the danger of explosion from improper support. The American Boiler Manufacturers' Association propose that the Massachusetts rules be modified in regard to the requirements for hanging boilers and that the boiler manufacturers be allowed to follow the present practice. Such a move would seem to be a step backward, and if any change is made it should be to require that the smaller sizer of boilers also be hung.

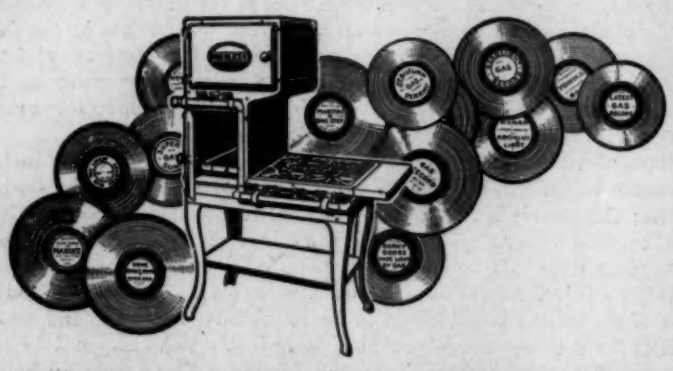
New Methods and Appliances.

Diffusing Plates of Marble.—In a recent issue of "Electrotechnische" is an account of some experiments with treated marble plates 0.14 inches thick, compared with opaline and ground glass thick enough to make the lamp filiment invisible. Calling the transparency of the treated marble as 100, that of opaline glass is 56 to 80, and of ground glass 300. The marble allows fewer of the yellow rays to pass than the opaline glass, but more red and more blue rays. Looking at prepared marble and opaline glass lighted equally, the former is more regularly illumined, and has a pleasing violet-red tint, while the latter seems greenish and dull. As diffusers of light, marble and opaline glass are on a par, and ground glass greatly inferior to both. With an equal consumption of energy, the light was better and more evenly distributed by the marble lantern. The transparency of marble and opaline glass for ultra-violet rays is about alike. The former is very slightly transparent to infra-red rays, considerably less than opaline glass, and even less than a sheet of water 0·4 inch deep, which is considered an excellent screen for heat rays. The agreeable character of the light diffused by the marble is probably due to the absence of heat rays, which disturb the eye.

Veritas Firing Rings.—In pottery and other clay industries the heat effect due to the increasing kiln temperature is frequently determined by the shrinkage of unburned clay rings, of uniform composition and size, placed in different parts of the kiln. The shrinkage is measured by means of a simple calipering device, which permits the reading of small differences in diameter. The Bureau of Standards has been correlating the arbitrary shrinkage number of the guage with temperatures measured by standardized thermocouples, so that the devices might be coordainated with pyrometer practice. The work consisted in firing a number of rings under conditions of constant temperature increase per unit time. Four firings were made, with increases in temperature of 50, 25, 16.66 and 12.5° C. per hour. At frequent intervals rings were withdrawn and their diameter measured after cooling. The results showing the shrinkage, expressed in numbers indicated by the guage and in fractions of an inch by micrometer measurement are given in tables. The temper-

ature at which equal contraction takes place are higher the more rapid the firing. The differences diminish as the temperature rises. The shrinkages for the two lower firing rates tend to coincide as the heat absorption becomes constant. Porosity determinations were made in connection with the shrinkage measurements, which resulted in curves practically parallel to the linear contraction. The firing rings were found to answer the purpose for which they are intended satisfactorily. A series of rings, intended for lower temperatures, was found unsatisfactory, owing to irregularities in shrinkage.

"THE RIGHT WAY IS THE GAS WAY."—The Consolidated Gas Company or New York is using a lot of space in the daily papers, which department is handled by Mr. R. E. Livingston. The idea is to cover every possible use of gas in the Metropolis; the ads generally describing some specific application, and occasionally a general appeal, as in the reproduction above, which gives an idea of their very good style and matter.



We Make a New Record Every Day

GOOD SERVICE Gas has been in use in this city ninety-one years, and during that time the supply has never failed to meet the demand. The Gas supplied has always been of the highest quality Not willing to stand on that record alone, we seek each day to excel the previous day's record for good service

IN THE HOME We are constantly installing ranges of various sizes that insure cool kitchens during the summer months. Gas cooking utensils are economical in the use of Gas. Any housewife will be given *free* cooking lessons in her home by one of our demonstrators

HOTELS, RESTAURANTS The efficiency of hundreds of kitchens in Hotels, Restaurants, Clubs, Bakeries, etc., etc., has been increased by the adoption of Gas for cooking and baking. Our appliances save floor space, they save the time of the chef and his assistants. With *our* fuel there is heat only while cooking is in progress, and then the heat is in the range, where it is serving its purpose

IN THE INDUSTRIES Manufacturers now know that Gas is unequaled as a fuel in every line of industrial endeavor. It furnishes heat at any desired temperature. It is always ready We have appliances for use in nearly every manufacturing line and our experts are at your service You can show economy in cost prices by substituting Gas for the fuel you are using. *Let us help you make a record in lower operating costs*

"The Right Way Is the Gas Way"

Consolidated Gas Company of New York

GEO. B. CORTELYOU, President

CATALYTIC PRODUCTION OF METHANE.—M. Vignon has been continuing his researches into the catalytic production of methane. He finds that carbonic oxide passed over lime at 1,000° C. together with steam gives 88 per cent. of hydrogen and 12 of methane, the lime remaining unaltered. Corresponding experiments with iron, nickel, copper, silica, alumina and magnesia gave the following results, the temperatures being those which gave a maximum yield of methane in each case, and the percentages given being those obtained after the removal of carbonic acid.

Catalyser.	Temperature C.	Methane. Volume Per Cent.	Hydrogen. Volume Per Cent.	Carbonic Oxide. Volume Per Cent.
Alumina.....	950	3.8	5.9	90.3
Magnesia.....	900	6.7	4.7	88.6
Silica.....	750	8.4	10.9	80.7
Iron.....	950	11.2	20.3	68.5
Nickel.....	400	12.5	1.5	86.0
Copper.....	700	6.3	2.2	91.5

The gas used consisted of 99.1 carbonic oxide and 0.9 hydrogen. He thinks that in the case of iron, alumina and silica an intermediate carbide is formed.

Items of Interest
FROM VARIOUS LOCALITIES.

NORTH PLATTE, Neb., the largest city in that State without a gas plant, no longer has that distinction. The first car load of material for the plant has arrived, and the North Platte Electric Company looks for good business from its combination service.

EFFORTS to arbitrate the differences between the employes of the Grand Junction (Col.) Electric Light, Gas and Power Company, who went on strike for an increase in wages, and the officials of the company have failed, and unless Superintendent, Manager and a force of section men can keep the light and gas plants going, the company faces a forefeiture of its contract with the city. President E. A. Sunderlin and Vice-President Charles C. Hamlin have been in conference with the strikers' committee and a mediating board from the Trades and Labor Assembly but failed to reach an agreement.

MR. H. L. RICE, who has tendered his resignation as General Manager of the Western United Gas & Electric Company and allied interests, will associate himself with Mr. Clement C. Smith and the Wisconsin Securities Company in operation and development of their various public utility enterprises, with headquarters at Milwaukee.

THE Brown Instrument Company will occupy its new factory at Wayne and Windrim Avenues, within a half block of Wayne Junction Station, Philadelphia, about October 1st. The building is two stories in height. and of the most modern construction for facilitating the manufacturing and calibrating of scientific instruments, A power plant will be installed and the finest mechanical equipment possible.

THE United Gas Improvement Company for the quarter ending June 30 has paid the City of Philadelphia $477,773.01 as against $464,564.63 last year. The total sales for the quarter just ended was 2,252,059,840 cubic feet and total collections were $2,289,096.30, including some sales in previous quarter Some of the collections date back for years, 108,110 cubic feet having been sold prior to January 1, 1908, 708,650 cubic feet sold between January 1, 1908, and January 1, 1913, and 2,388,279,340 cubic feet were sold subsequently. In connection with these collections there was some money for service rendered by the city prior to the execution of the lease in November, 1897, these total collections now amounting to $709,744.51, has been turned over as collected.

MAYOR E. B. JERMYN of Scranton, Pa., announces that when council holds its next meeting he will send a special message urging that provision be made next year for the installation of gas lighting in the streets of the city which are dark in the summer time because of the shade trees. The mayor got his idea from Buffalo where the system is in vogue and where he says it gives the greatest possible satisfaction.

ANNOUNCEMENT is made of changes in the personnel of the firm of R. D. Wood & Company, of Philadelphia, made necessary by the death of Mr. Stuart Wood. The business will be continued under the same name by the surviving partner, Mr. Walter Wood. The name of R. D. Wood & Company has for more than 100 years stood for the best in iron work, and examples of their work in gas holders and gas works apparatus are all over the country.

THE service now being given by the Cranford (N. J.) Gas Light Company to its patrons in Westfield and vicinity is much better than that rendered ten days ago, on account of the new holder at Graceland being put in use. It can contain 750,000 cubic feet. H. B. Udell, Secretary of the Company, has received many compliments regarding the better service.

AT the annual meeting of the stockholders of the Alliance (Ohio) Gas and Power Company, in Cleveland, the following directors were elected: H. L. Doherty, Frank W. Frueauff, New York; George W. York, N. C. Harvey, D. W. Lowe and W. J. Drum, Cleveland; and W. J. Rose of Alliance. These officers were then elected: President, H. L. Doherty; 1st Vice President, Frank W. Frueaff; 2nd Vice President, Geo. W. York; General Manager and Treasurer, W. J. Rose; Secretary, Edwin Wagner.

IT is reported that a company, with headquarters in Detroit, will ask for a gas franchise for Muskegon Heights, Mich., and build a plant there. The matter of securing a franchise will be submitted to the council at a near meeting. At the present time the officials are looking over the ground more thoroughly and are securing data to place before the council, that will make their appeal stronger.

OUR only war news is that the Massachusetts Gas Company own 4 colliers which could be immediately placed in condition for trans-Atlantic service. These boats, flying the American flag, have a capacity of about 7,000 tons each, and could be very readily used for transportation of grain. The management, however, has as yet received no offers for them as grain carriers.

VAHEY & CASSON, attorneys on behalf of their clients, who are all Italians, seek to recover because of the "intolerable, noxious and noisome stenches, vapors and gases" blowing upon the lands of the plaintiffs from the gasometer which the Boston Consolidated Gas Company is alleged to maintain on Prince street. One of the other points at issue is the noise said to be made by the machinery used in operation of the gasometer. The plaintiffs claim that occupation of their dwellings is made "unbearable, unhealthy, intolerable and impossible." Which is the undesirable neighbor?

MR. J. J. ROWE has moved to Elkhart, Ind., from Holland, Mich., to take the management of the new business department of the Elkhart Gas and Fuel Company. Mr. Rowe has been connected with the gas business practically all his life, and is thoroughly experienced in all branches of the business, having been Superintendent of the plant at Holland, which is owned by the Grand Rapids syndicate in control of the local company. His long years of experience well equips him for the work in Elkhart, which has been well begun by the company and which is to be vigorously pushed Mr. Rowe succeeds Mr. R. E. Anglin, resigned.

THE Boston Consolidated Gas Company, this year, is to distribute $50,840 as a share of the profits to 643 of its most efficient employees, the rate of profit-sharing being 8 per cent. of the wages of the employee. The rate is the same as that paid in dividends on the company's stock. The amount distributed this year is the largest ever given out in the company's profit-sharing scheme, except in 1912, and the number of persons sharing it has been exceeded but once. About 3,200 shares of preferred stock are held by employees of the company.

COMMENCING August 1st the Rahway (N. J.) Gas Light Company inaugurated its new schedule of rates and also the reduction in the time limit to pay bills to secure the discount. Bills will be rendered from this date at $1.10 per 1,000 cubic feet, instead of $1.25 as formerly, and a discount of 20 cents per 1,000, instead of 35 cents, allowed on all bills where 600 feet or more have been consumed, but bills must be paid by the 10th of the month positively, as no discount will be allowed after that date. The change in price is only technical, as with the reduction of 20 cents it remains the same as before, viz., 90 cents net if paid by the 10th of the month.

AT the annual meeting of the stockholders of the Fall River (Mass.) Gas Works Company, officers were elected as follows:

President—Frederick P. Royce.
Vice-President—George P. Brown.
Clerk—William F. Crawford.
Treasurer—Henry B. Sawyer.
Directors—Philip Dexter, Boston; Alfred C. Foster, Milton; Geo. C. Lee, Westwood; Russell Robb, Concord; Frederick P. Royce, Dedham; Philip Stockton, Manchester; Edward R. Utley and Edwin S. Webster, Newton.

Joseph E. Nute, Manager, and Sidney E. Baker, Assistant Treasurer, hold positions under control of the Board of Directors, so far as their filling is concerned, and having been elected to serve during the pleasure of the Board, were not up for election at this meeting.

NOTICE has been given by the Cumberland (Md.) Gas Light Company to the consumers that after September 20th that company will cease to manufacture gas, and will close its plant. In accordance with a ruling of the Public Service Commission, the consumers are given 48 days to secure other lighting and heating service. This follows the application filed several months ago by the Gas Light Company to quit business, which was granted by the Public Service Commission at a recent hearing. The company, in their application, stated that the high cost of materials in the manufacture of gas made it impossible for them to compete with the Natural Gas Company or the Edison Electric Company, and that they were operating their plant at a loss. The Cumberland Gas Company was organized in 1850 and operated under a charter granted by the State Legislature.

VOTERS of Greeley, Col., will be called upon to vote upon a strictly local issue foreign to politics on State Primary Day, Sept. 8th, when the Greeley Fuel and Gas Company will submit the question of vacating a street to that company in return for a reduction of 10 cents per 1,000 in the price of gas to local consumers.

THE ordinance passed by the Youngstown, O., City Council ordering the owners of all buildings in the city fire limits to install automatic gas valves, is causing dissatisfaction. The complaint is that the cost of the new valves is too high, and that the same results can be had by fitting an ordinary stop-cock on the outside of the building, which could, in case of fire, be turned off and the gas shut out of the entire building. The cost of this would be but a few dollars, while property owners claim that the automatic valve and its installation would cause the expenditure of nearly $50.

BY an agreement made in October, 1911, in accordance with an empowering act of the 1908 Legislature, a deed was filed in the Registry of Deeds last week conveying the real and personal property of the Chicopee (Mass.) Gas Light Company to the Springfield Gas Light Company. All of the property is located in Chicopee and includes gas holders, pipes, retorts and other appliances in addition to several small parcels of land.

MAYOR HALL, of Aberdeen (S. D.) has submitted a report to the city commissioners recommending that a contract be entered into with the Aberdeen Gas Company renewing its street lighting contract for a period of five years at a price of $2.50 per lamp per month, a reduction of 50 cents per month under the price which the city has been paying. The motion was carried and the contract will be entered into. Negotiations have been pending for several months in order to secure the reduction.

AFTER deliberating and discussing the gas franchise which was adopted by Pern, Ill., on June 8th, and rejected by the Citizens Lighting Co., the controversy has at last been settled. An ordinance amending several sections in the franchise not acceptable to the gas company was adopted by the aldermen. Part of the franchise embodying a rate of $1.25 per 1,000 for the first 5,000 cubic feet, $1.15 from 5,000 to 50,000 cubic feet and $1 per 1,000 for all gas over 55,000 cubic feet, less a 10 per cent. cash discount on all bills paid by the 10th of the month, was accepted by the gas company. It is the company's intention to immediately begin enlarging its gas mains and also make other necessary changes in the existing system.

THE July output of the Boston Consolidated Gas Company was 363,597,000 cubic feet, the largest output for that month on record, and an increase of 8.94 per cent. over the corresponding month a year ago.

OPELIKA, GA., is to have a gas plant. The city council has granted a franchise to Wm. M. Jenkins for the construction of a gas plant for the manufacture and distribution and sale of natural or manufactured gas. Mr. Jenkins is the President of the American Gas and Utility Company, of Atlanta. This company has recently been granted franchises to build gas plants in Newman, Cedartown and Cordele, Ga. The franchise provides that the rate will not be more than $1.50 per 1,000 cubic feet. The period of the franchise is for thirty years. At the end of each period of ten years the city of Opelika to have the right of option in purchasing the plant. Work to commence in one year after the ordinance becomes a law, and the Company to provide gas in two years.

THE Cambridge (Mass.) Gas Light Co., has certainly solved the labor problem as far as contentment and loyal service are concerned. All of the employees of this company, except the president, will receive the annual dividend of 5 per cent. of their wages this year, following out the profit-sharing custom established three years ago. Ten thousand five hundred dollars is the sum to be thus distributed among 230 men and women.

Utilities Commission News.

BOND ISSUE AUTHORIZED.—The up State Public Service Commission has authorized the Central New York Gas and Electric Company to issue $128,000 of its 5 per cent first mortgage gold bonds, at no less than 90, to net $115,200. The money will be expended for a 100,000-foot holder in Phelps and one in Lyons, and for mains, service pipes and other equipment in Phelps, Palmyra, Newark and Lyons, making a total for the gas department of the company of $31,739.50.

MUST SUBMIT DATA.—Public service corporations in Minnesota will be required to submit to the Minnesota Tax Commission complete data as to their properties, according to an announcement made by J. G. Armson, Chairman of the Commission. The data must include a complete description of the holdings of the various concerns, capitalizations, stock and bond issues, gross and net income, market value of securities, operating expenses and other information which may enable the Commission to fix the assessment on a proper basis.

BOARD INSPECTS PLANTS AND TERRITORY.—Following the inspection by members of the New Jersey Board of Public Utilities, a decision is expected on the fight for cheaper gas, started two years ago, affecting 70 or more towns and hamlets in Cumberland, Gloucester, Salem and Camden Counties. Officials of ten of the larger towns are allied in a contest against the New Jersey Gas Company, with Central plant at Glassboro, to get the price of gas reduced from $1.50 per 1,000 cubic feet, less 8 per cent. for cash, to $1 flat. The gas company officials endeavored to impress upon the Board that they have 270 miles of pipe to supply their territory, large areas of which are sparsely settled. Its total population is estimated at 45,000, with 8,000 meters on the system, and a gas consumption that averages $25,000,000 cubic feet a year. One point that is expected to score strongly for the towns is the fact that the same gas that is piped within a radius of a few miles of the plant and sold at the $1.50 rate, is carried through mains 16 miles to Vineland and there sold for $1. The gas company's explanation is that it was compelled to accept the $1 rate in the Vineland district because it was specified in the franchise of the company which was bought out.

INADEQUATE RETURN NOT SUFFICIENT EXCUSE.—An order issued by the State Public Service Commission of Washington, requires that the Seattle Lighting Company extend its gas mains into West Seattle for the purpose of serving one customer, Benjamin E. DeRoy. The commission holds that he is entitled to the service, notwithstanding the excessive cost of making the improvement on the part of the company.

DISTRICT OF COLUMBIA STANDARDS.—Establishing a new standard for manufactured gas based on the heating rather than the illuminating power of the product, the public utilities commission have adopted regulations for gas service in the District of Columbia, to become effective September 1. They will be enforced by a branch of the commission to be known as the gas inspection bureau.

Under the regulations. gas manufactured in the District must have a monthly average total heating value of not less than 600 B. T. U's. per cubic foot, with a minimum of 550.

It is provided that when a test reveals less than 600 units other tests shall be made at once, and the average of all the readings taken as the heating value for that day.

With respect to impurities the regulations require that gas shall not show the presence of any hydrogen sulphide and shall contain not more than thirty grains of sulphur or five grains of ammonia in 100 cubic feet of gas.

Requirements as to testing meters, are that a variation of more than 2 per cent. of error shall not be allowed; that at least once every 5 years each meter shall be tested by the company for accuracy: that each company shall, without charge, test the accuracy of a meter upon request of a consumer, provided it has not been tested within 1 year previous, and that upon application of any company to the gas inspection bureau a test shall be made of the consumer's meter by the bureau.

MUST OBTAIN PROPER FRANCHISE.—The California commission holds that the application of the Oakdale Gas Company for a certificate permitting it to construct and operate a gas distributing system in the town of Riverbank, and to construct a transmission main from its generator in Oakdale, would be granted when the applicant obtained a franchise meeting the requirements of the commission. The proposed franchise was criticised chiefly because it fixed rates, a power conferred on the commission with respect to unincorporated territory, and because it allowed the applicant 3 years to complete the installation of the gas system, which the commission held was longer than necessary.

Financial Notes.

THE Bond Department of H. M. Byllesby and Company reports as follows relative to the earnings and expenses of tho Northern States Power Company and subsidiaries:

Month of June.	1913.	1914.	Increase.	Per Cent.
Gross Earnings.....	$270,310	$307,426	$37,116	13.7
Expenses and Taxes.	137,528	155,024	17,496	12.7
Net Earnings	$132,782	$152,402	$19,619	14.7
6 months ended June 30th.				
Gross Earnings.....	$1,175,700	$1,319,343	$143,642	12.2
Expenses and Taxes.	613,231	645,670	32,438	5.2
Net Earnings.....	$562,468	$673,673	$111,204	19.7
12 months ended June 30th.				
Gross Earnings.....	$3,745,841	$4,078,541	332,700	8.8
Expenses and Taxes.	1,851,259	1,956,002	104,742	5.6
Net Earnings	$1,894,581	$2,122,539	$227,957	12.0
Fixed Charges.....	1,178,070	1,240,764	62,694	5.3
Surplus.....	$716,510	881,774	$165,263	23.0
Pfd. Stk. Dividends..	554,013	587,069	33,055	5.9
Balance	$162,497	$294,705	$132,208	81.3

THE St. Petersburg (Fla.) bond issue has been passed upon by prominent Chicago attorneys and endorsed. The buyers, John Nuveen and Company, has notified the city that the money will be paid as soon as the Commissioners attach their signatures. Work on the gas plant has been going ahead at a good rate—the contractors for the work, McCrary Company, advancing the money.

PACIFIC GAS & ELECTRIC COMPANY, in offering the unsubscribed balance of the $12,500,000 first preferred stock of the company to the general public until August 15, the exclusive right of stockholders to subscribe having ended July 15, is urging gas and electric customers of the company to take the new stock. Officers of the company say that they have received requests for shares of the new stock from a number of customers, and so decided to get out a special circular and send it to all customers of the corporation offering them the stock and explaining its merits. While price of the stock to the customers is the same as to the general public, the company points out advantages to the customers of being stockholders in the company which furnishes them their gas and electric current.

THE regular quarterly dividend (sixth quarter) on 1¾ per cent. has been declared on the preferred stock of the J. G. White Management Corporation, payable September 1, 1914, to stockholders of record August 18, 1914.

MORE than a billion and a quarter cubic feet of gas were sold by the Western United Gas and Electric Company in 56 cities and towns last year, according to a report issued recently. From this gross earnings were $1,348,676.40, which after all interest charges left a net income of $318,789.96. During the year 13 new towns were added and 124 miles of mains laid. Since the first of the year many miles of new mains have been laid in the big line leading from the Joliet plant, which is to furnish gas for the entire district. At the end of the year the company had 871 miles of mains. The combined population of the cities and towns which the company enters is more than 350,000; it has long time franchises and is without competition in places it serves. A comparison of gross earnings for 9 years follows:

1906	$532,759.46
1907.....	860,199.43
1908.....	988,485.12
1909.....	1,036,379.35
1910..	1,102,938,68
1911.....	1,230,373.73
1912.....	1,312,127.64
1913.....	1,359,338.74
1914.....	1,348,676.40

Col. Ira C. Copley is President of the company and personally directs its policy and operation.

EAST Boston Gas and Newton and Watertown Gas subsidiaries of Massachusetts Gas, have withdrawn their applications for new stock issues, filed with the Massachusetts Gas Commission. This is believed to forecast a consolidation of these companies with Boston Consolidated Gas, a step which would probably meet with little or no opposition.